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Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 15–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29–30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes, First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1–3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixthAnnual Meeting, Atlanta, Ga., Dec. 31, 1913–Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28–31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9–10, 1915. (Officers same as for Twenty-eighth Annual Meeting.)

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27–30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28–30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917–Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26–27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President, G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

Thirty-second Annual Meeting, St. Louis, Mo., Dec. 31, 1919–Jan. 2, 1920. President, W. C. O'Kane; First Vice-President, A. G. Ruggles; Second Vice-President, H. J. Quayle; Third Vice-President, E. C. Cotton; Fourth Vice-President, W. E. Britton; Secretary, A. F. Burgess.

Thirty-third Annual Meeting, Chicago, Ill., Dec. 29–31, 1920. President, Wilmon Newell; First Vice-President, H. A. Gossard; Second Vice-President, E. M. Ehrhorn; Third Vice-President, J. G. Sanders; Fourth Vice-President, F. B. Paddock; Secretary, A. F. Burgess.

Thirty-fourth Annual Meeting, Toronto, Canada, Dec. 29–31, 1921. President, George A. Dean; First Vice-President, Arthur Gibson; Second Vice-President, E. O. Essig; Third Vice-President, A. G. Ruggles; Fourth Vice-President, H. F. Wilson; Secretary, A. F. Burgess.

Thirty-fifth Annual Meeting, Boston, Mass., Dec. 28–30, 1922. President, J. G. Sanders; First Vice-President, J. M. Swaine; Second Vice-President, A. L. Lovett; Third Vice-President, R. W. Harned; Fourth Vice-President, M. C. Tanquary; Secretary, A. F. Burgess.

Thirty-sixth Annual Meeting, Cincinnati, Ohio, Dec. 29, 1923–Jan. 2, 1924. President, A. G. Ruggles; First Vice-President, H. A. Gossard; Second Vice-President, H. J. Quayle; Third Vice-President, P. A. Glenn; Fourth Vice-President, S. B. Fracker; Secretary, A. F. Burgess.

Thirty-seventh Annual Meeting, Washington, D. C., December 31, 1924–January 3, 1925. President, A. F. Burgess; First Vice-President, M. C. Tanquary; Second Vice-President, H. S. Smith; Third Vice-President, E. R. Sasscer; Fourth Vice-President, R. W. Harned; Secretary, C. W. Collins.

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Urich, F. W., Department of Agriculture, Port of Spain, Trinidad, West Indies.
Vermorel, V., Station Viticole, Villefranche, Rhone, France.

JOURNAL
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Proceedings of the Thirty-Seventh Annual Meeting of the American Association of Economic Entomologists

The thirty-seventh annual meeting of the American Association of Economic Entomologists was held in the Armory of the Central High School, Washington, D. C., December 31, 1924 to January 3, 1925.

The Section of Apiculture convened at 9:45 a. m., December 31, holding a busy morning session at which papers were read and discussed and business transacted.

The Section of Plant Quarantine and Inspection met at 1:30 p. m., December 31. Some very interesting papers were presented and discussed at length.

On the evening of January 1 the Extension Entomologists held a conference at the Hotel Harrington. This, too, was an interesting meeting at which many good ideas were brought out in discussion. About 75 to 100 members attended.

The opening meeting of the general association was called to order at 9:45 a. m., Thursday, January 1, 1925, by President A. F. Burgess.

The annual reports were read and the business of the opening session was transacted. The address of the President was delivered before the close of the first session. The sessions were continued in the afternoon, throughout Friday and were concluded with a final business session on Saturday.

The papers on the program were grouped under sub-headings with reference to projects as Insects Affecting Fruits, Insects Affecting Field and Forage Crops, Insects Affecting Truck Crops, Insecticides, etc.

Conferences on the Hessian Fly and Japanese Beetle were held during the period of the meeting which were well attended—giving opportunities for exchange of ideas by specialists in these projects.

The business proceedings form Part I of this report, and the addresses, papers, and discussion, Part II.

The proceedings of the Sections on Apiculture and Plant Quarantine and Inspection, together with a summary of the conference of extension entomologists, are also included.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President A. F. Burgess at 9:45 a. m., January 1, 1925 (Thursday). Over 300 members and visitors attended the sessions. The following members were present:

Ackerman, A. J., Bentonville, Ark.
Ainslie, C. N., Sioux City, Iowa
Ainslie, G. G., Knoxville, Tenn.
Alden, C. H., Fort Valley, Ga.
Ashworth, J. T., Danielson, Conn.
Baker, A. C., Washington, D. C.
Baker, Howard, Silver Spring, Md.
Back, E. A., Washington, D. C.
Baerg, W. J., Fayetteville, Ark.
Bailey, H. L., Bradford, Vt.
Ball, E. D., Washington, D. C.
Barber, G. W., Arlington, Mass.
Barber, H. S., Washington, D. C.
Bentley, G. M., Knoxville, Tenn.
Berger, E. W., Gainesville, Fla.
Beyer, A. H., Gainesville, Fla.
Bilsing, S. W., College Station, Tex.
Bishopp, F. C., Dallas, Texas.
Bissell, T. L., Ithaca, N. Y.
Blackman, M. W., Syracuse, N. Y.
Bondy, F. F., Tallulah, La.
Borodin, D., New York, N. Y.
Bourne, A. I., Amherst, Mass.
Brinley, F. J., Willow Grove, Pa.
Britton, W. E., New Haven, Conn.
Broadbent, B. M., (Miss) Washington, D. C.
Brooks, F. E., French Creek, W. Va.
Bulger, J. W., Columbus, Ohio
Burdette, R. C., College Park, Md.
Burgess, A. F., Melrose Highlands, Mass.
Caffrey, D. J., Arlington, Mass.
Cagle, L. R., Blacksburg, Va.
Campbell, R. E., Alhambra, Calif.
Cartwright, W. B., Centralia, Ill.
Caudell, A. N., Washington, D. C.
Chafin, Jeff, Gainesville, Fla.
Chapman, P. J., Ithaca, N. Y.
Chapman, R. N., Minneapolis, Minn.
Colcord, Mabel, Washington, D. C.
Cole, F. R., Orlando, Fla.
Collins, C. W., Melrose Highlands, Mass.
Corkins, C. L., Laramie, Wyo.
Cory, E. N., College Park, Md.
Cotton, R. T., Washington, D. C.
Craighead, E. M., Guernsey, Pa.
Craighead, F. C., Washington, D. C.
Cressman, A. W., New Orleans, La.
Crosby, C. R., Ithaca, N. Y.
Crossman, S. S., Melrose Highlands, Mass.
Culver, J. J., Vienna, Va.
Cutright, C. R., Wooster, Ohio
Davis, J. J., Lafayette, Ind.
Dean, George A., Washington, D. C.
DeLong, D. M., Columbus, Ohio
Doane, R. W., Stanford University, Calif.
Dohanian, S. M., Melrose Highlands, Mass.
Doucette, C. F., Willow Grove, Pa.
Dowden, P. B., Melrose Highlands, Mass.
Drake, C. J., Ames, Iowa
Dunnam, E. W., Florence, S. C.
Dusham, E. H., State College, Pa.
Dye, H. W., Middleport, N. Y.
Eckert, J. E., Raleigh, N. C.
Ellington, G. W., Washington, D. C.
Ewing, H. E., Washington, D. C.
Evenden, J. C., Coeur d'Alene, Idaho
Eyer, J. R., North East, Pa.
Fackler, H. L., Knoxville, Tenn.
Faxon, Richard, Columbus, Ohio
Felt, E. P., Albany, N. Y.
Fenton, F. A., Florence, S. C.
Fink, D. E., Riverton, N. J.
Fleming, W. E., Riverton, N. J.
Flint, W. P., Urbana, Ill.

Fox, Henry, Macon, Ga.
Fracker, S. B., Madison, Wis.
Frison, T. H., Urbana, Ill.
Frost, S. W., State College, Pa.
Garman, H., Lexington, Ky.
Garman, Philip, New Haven, Conn.
Gay, G., New York, N. Y.
Gibson, Arthur, Ottawa, Can.
Glasgow, Hugh, Geneva, N. Y.
Glenn, P. A., Urbana, Ill.
Good, H. G., Auburn, Ala.
Goodwin, J. C., Gainesville, Fla.
Gossard, H. A., Wooster, Ohio
Graf, J. E., Washington, D. C.
Granovsky, A. A., Madison, Wis.
Griswold, Grace H., Ithaca, N. Y.
Guyton, T. L., Harrisburg, Pa.
Haack, T. T., Philadelphia, Pa.
Hadley, C. H., Harrisburg, Pa.
Haley, W. E., New Orleans, La.
Hall, M. C., Washington, D. C.
Hallock, H. C., Riverton, N. J.
Hambleton, J. T., Washington, D. C.
Hamilton, C. C., College Park, Md.
Harned, R. W., Agricultural College, Miss.
Harris, J. A., Raleigh, N. C.
Hartley, E. A., Syracuse, N. Y.
Hartzell, Albert, Yonkers, N. Y.
Hayes, W. P., Urbana, Ill.
Headlee, T. J., New Brunswick, N. J.
Herrick, G. W., Ithaca, N. Y.
Hertzog, P. H., Hightstown, N. J.
Hine, J. S., Columbus, Ohio
Hodgkiss, H. E., State College, Pa.
Holloway, T. E., New Orleans, La.
Hood, C. E., Melrose Highlands, Mass.
Hooker, W. A., Washington, D. C.
Horsfall, J. L., Bustleton, Pa.
Horton, J. R., Wichita, Kans.
Hough, W. S., Winchester, Va.
Houser, J. S., Wooster, Ohio
Howard, L. O., Washington, D. C.
Howard, N. F., Birmingham, Ala.
Huber, L. L., Wooster, Ohio
Huckett, H. C., Geneva, N. Y.
Hungerford, H. B., Lawrence, Kans.
Hutson, Ray, New Brunswick, N. J.
Hyslop, J. A., Washington, D. C.
Ingram, J. W., Crowley, La.
Jones, D. W., Arlington, Mass.
Jones, M. P., Columbus, Ohio
Jones, T. H., Melrose Highlands, Mass.
Kelly, E. G., Manhattan, Kans.
Kenney, C. H., Columbus, Ohio
King, J. L., Riverton, N. J.
Kisliuk, Max, Jr., Philadelphia, Pa.
Knowlton, G. L., Salt Lake City, Utah
Knull, J. N., Hummelstown, Pa.
Lane, M. C., Toppenish, Wash.
Langford, G. S., Fort Collins, Colo.
Larrimer, W. H., W. Lafayette, Ind.
Lathrop. F. H., Clemson College, S. C.
Leach, B. R., Riverton, N. J.
Leiby, R. W., Raleigh, N. C.
Liu, C. L., Ithaca, N. Y.
Lowry, P. R., Durham, N. H.
Lowry, Q. S., Boston, Mass.
Luginbill, Philip, Columbia, S. C.
Lyle, Clay, A. & M. College, Miss.
Mabee, W. B., Raleigh, N. C.
MacAloney, H. J., Syracuse, N. Y.
MacLeod, G. F., State College, Pa.
Maloney, J. O., Washington, D. C.
Manter, J. A., Storrs, Conn.
Marcovitch, S., Knoxville, Tenn.
Marlatt, C. L., Washington, D. C.
Mathewson, A. A., Columbus, Ohio
McClendon, S. E., Thomasville, Ga.
McColloch, J. W., Manhattan, Kan.
McDonnell, C. C., Washington, D. C.
McIndoo, N. E., Washington, D. C.
McLaine, L. S., Ottawa, Can.
Merrill, G. B., Gainesville, Fla.
Metcalf, C. L., Urbana, Ill.
Metcalf, Z. P., Raleigh, N. C.
Metzger, F. W., Riverton, N. J.
Middleton, William E., Falls Church, Va.
Minott, C. W., Melrose Highlands, Mass.
Mitchell, T. B., Raleigh, N. C.
Montgomery, J. H., Gainesville, Fla.
Moore, William, New York, N. Y.
Morgan, A. C., Clarksville, Tenn.
Morrison, Harold, Washington, D. C.
Myers, P. R., Carlisle, Pa.
Neiswander, C. R., Wooster, Ohio
Newell, Wilmon, Gainesville, Fla.
Nickels, C. B., Clemson College, S. C.

Nolan, W. J., Washington, D. C.
O'Byrne, F. M., Gainesville, Fla.
O'Kane, W. C., Durham, N. H.
Osborn, Herbert, Columbus, Ohio
Osburn, R. C., Columbus, Ohio
Parker, R. L., Ames, Iowa
Parrott, P. J., Geneva, N. Y.
Parks, T. H., Columbus, Ohio
Peirson, H. B., Augusta, Me.
Peterson, Alvah, New Brunswick, N. J.
Phillips, E. F., Ithaca, N. Y.
Phillips, W. J., Charlottesville, Va.
Plank, H. K., New Orleans, La.
Popenoe, C. H., Washington, D. C.
Poos, F. W., Sandusky, Ohio
Porter, B. A., Vincennes, Ind.
Potts, S. F., Columbus, Ohio
Powers, E. B., Knoxville, Tenn.
Quaintance, A. L., Washington, D. C.
Readio, P. A., Lawrence, Kans.
Ressler, I. L., New York, N. Y.
Richardson, C. H., Washington, D. C.
Ries, D. T., Ithaca, N. Y.
Roberts, H. E., Webster Groves, Mo.
Rogers, D. M., Boston, Mass.
Rohwer, S. A., Washington, D. C.
Safro, V. I., Clarksville, Tenn.
Sanders, G. E., Medina, N. Y.
Sanders, J. G., Philadelphia, Pa.
Sanders, P. D., College Park, Md.
Sanford, H. L., Washington, D. C.
Sasscer, E. R., Washington, D. C.
Satterthwait, A. F., Webster Groves, Mo.
Scammell, H. B., Toms River, N. J.
Schoene, W. J., Blacksburg, Va.
Severin, H. C., Brookings, S. D.
Shafer, G. D., Palo Alto, Calif.
Sherman, Franklin, Jr., Raleigh, N. C.
Siegler, E. H., Washington, D. C.
Simmons, Perez, Silver Spring, Md.
Smith, A. G., Pasadena, Calif.
Smith, C. E., Baton Rouge, La.
Smith, F. F., Harrisburg, Pa.
Smith, G. A., Boston, Mass.
Smith, G. L., Tallulah, La.
Smith, Harry S., Riverside, Calif.
Smith, H. D., Carlisle, Pa.
Smith, L. B., Riverton, N. J.
Smulyan, M. T., Melrose Highlands, Mass.
Snyder, T. E., Washington, D. C.
Spencer, Herbert, Norfolk, Va.
Stear, J. R., Chambersburg, Pa.
Stearns, L. A., New Brunswick, N. J.
Stewart, M. A., Washington, D. C.
Stockwell, C. W., Riverton, N. J.
Strong, L. A., Washington, D. C.
Sturtevant, A. P., Washington, D. C.
Sutton, F. J., Middleport, N. Y.
Swingle, H. S., Columbus, Ohio
Symons, T. B., College Park, Md.
Thomas, F. L., College Station, Tex.
Thomas, W. A., Chadbourn, N. C.
Thomas, W. W., Orlando, Fla.
Underhill, G. W., Richmond, Va.
Vance, A. M., Charlottesville, Va.
Van Dine, D. L., Havana, Cuba
Van Leeuwen, E. R., Riverton, N. J.
Vickery, R. A., Arlington, Mass.
Wade, J. S., Washington, D. C.
Walter, J. E., Washington, D. C.
Walton, W. R., Washington, D. C.
Webb, J. L., Washington, D. C.
Webber, R. T., Melrose Highlands, Mass.
Weigel, C. A., Washington, D. C.
Weld, L. H., E. Falls Church, Va.
Wellhouse, W. H., Ames, Iowa
White, G. F., Washington, D. C.
White, W. H., Washington, D. C.
Whitmarsh, R. D., Milwaukee, Wis.
Willey, C. R., Blacksburg, Va.
Wolcott, G. N., Port-au-Prince, Haiti
Wood, W. B., Washington, D. C.
Worthley, H. N., Amherst, Mass.
Worthley, L. H., Arlington, Mass.
Yothers, W. W., Orlando, Fla.
Young, M. T., Tallulah, La.
Zappe, M. P., New Haven, Conn.

PRESIDENT A. F. BURGESS: The Association will please come to order. The first business is the Report of the Secretary.

REPORT OF THE SECRETARY

The membership of the association at the time of the Cincinnati meeting together with the election of new members, resignations and losses by death since, is summarized as follows:

	Active	*Associate*	*Foreign*
	322	342	48
Transferred from Associate to Active—Cincinnati meeting	+ 34	— 34	
	356	308	48
Re-instated—Cincinnati meeting	+ 1	+ 3	
Members elected— " "		+ 64	+ 1
	357	375	49
Dropped for non-payment of dues, 1924	— 3	— 13	
Resignations accepted, last meeting	— 3	— 6	
Deaths recorded since last meeting	— 3	— 3	— 1
Total membership—Washington meeting	348	353	48
Grand Total	749		
Net gain during 1924	37		

Dr. Alexander MacGillivray, an active member, died at Urbana, Ill., March 24, 1924, at the age of 56. He had published many papers on systematic entomology and was professor of systematic entomology in the University of Illinois from 1917 to the time of his death. He was a member of this association of long standing and his presence and wise counsel is greatly missed by all who knew him.

Prof. Arthur L. Lovett, an active member, died at Corvallis, Oregon, April 25, 1924, from septicemia poisoning at the early age of 39. He went to Oregon Agricultural College in 1911 from Oklahoma A. & M. College. In 1917 he was raised to the rank of Professor which position he held at the time of his death. He was known as a leader in our profession, possessing a wide knowledge of insects of economic importance in the Pacific Northwest.

R. C. Treherne, an active member, died June 7, 1924 at Ottawa, Canada, from acute peritonitis, at the early age of 38. At the time of his death he was Chief of the Division of Field Crops and Garden Insects of the Entomological Branch, Dominion of Canada. He was an energetic and tireless worker, having published several papers on economic insects and was becoming a leading authority on the Thysanoptera. By his untimely death our Association and Entomology has suffered a real loss.

Frank M. Littler, an associate member since 1916, died of Typhoid fever, July 1922. He was located at Launceston, Tasmania, since becoming a member of this Association. Notice of his death without details was not received until the present year.

Edgar L. Dickerson of Nutley, N. J., an associate member, died Oct. 30, 1923, following an operation, at the age of 45. He had been a member a long time, was connected with the New Jersey Board of Agriculture and worked with the late John B. Smith of that state, furnishing many valuable records for the latter's Report of the Insects of New Jersey. At the time of his death he was head of the Department of Biological Sciences and Commercial Geography, Central High School, Newark, N. J.

W. B. Turner, Junior Entomologist, U. S. Bureau of Entomology, an associate member, died June 11, 1924, at Sacramento, Calif. He had been with the Bureau since 1910 and was a faithful worker—being last identified with the division of Cereal and Forage Insect Investigations but previously with Forest Insect Investigations and Gipsy and Brown-tail Moth Investigations.

Prof. Karl Sajo of Godollo-Veresegyhaz, Hungary, a foreign member, died during the spring or early summer of 1924. I have no details of his death or career.

The annual meeting of the Pacific Slope Branch was held at Stanford University, California, June 27-28, 1924. The meeting was very well attended and the papers presented have been published in the October number of the JOURNAL OF ECONOMIC ENTOMOLOGY.

PERMANENT FUND

In accordance with instructions from the Executive Committee, $400 was transferred from the Association Fund to the Permament Fund. With this amount and $599.46 from the Permanent Fund, a $1,000 4¼% Liberty Bond was purchased and is held for this fund. The interest on bonds and on savings bank deposits has been credited to the fund as shown in the financial statement.

ASSOCIATION STATEMENT

Balance in Treasury, December 4, 1923		$492.65
Amount received from dues, 1924		1187.00
Amount received from Malden National Bank, Interest		16.86
Amount received from Loan		150.00
Paid—Stenographic Report, 1923 meeting	$109.99	
Postage	74.55	
Programs and Notices	8.52	
Supplies and Stationery	133.00	
Telegraph and Express	9.95	
Returned Checks	4.00	
Expenses of Pacific Slope Branch	14.48	
Funds Transferred	400.00	
Dues—International Apicultural Congress	10.00	
Secretary	50.00	
Clerical Work, Secretary's Office	45.00	
Balance, November 29, 1924	987.02	
	$1846.51	$1846.51

Balance, Deposited in First National Bank, Malden, Mass.

JOURNAL STATEMENT

Balance in Treasury, December 4, 1923		$1447.77
Amount received from subscriptions, advertising, etc.		4629.70
Amount received from bank interest		33.71
Paid—Postage	$ 120.00	
Printing	2799.29	
Programs and notices	14.50	
Supplies and stationery	6.50	
Half-tones	182.65	
Telegraph, express and carfares	9.20	

Returned checks	18.50	
Refunded Subscriptions	3.15	
Editor	100.00	
Clerical work, Editor's Office	75.00	
Secretary	50.00	
Clerical work, Secretary's Office	45.00	
Balance, November 29, 1924	2687.39	
GRAND TOTAL	$6111.18	$6111.18

Balance deposited in First National Bank, Malden, Mass.

INDEX I STATEMENT

Balance in Treasury, December 4, 1923		$425.38
Received from sales		153.59
Amount received from interest		8.42
Paid for Postage	3.12	
Transferred funds	40.54	
Balance, November 29, 1924	543.73	
GRAND TOTAL	$587.39	$587.39
Balance, deposited in Melrose Trust Company	$474.34	
Balance deposited in First National Bank, Malden, Mass.	69.39	
	$543.73	

INDEX II STATEMENT

Balance in Treasury, December 4, 1923		$6.59
Received from sales		161.55
Paid for Postage	$4.50	
Paid for Loans	150.00	
Balance, November 29, 1924	13.64	
GRAND TOTAL	$168.14	$168.14

Balance Deposited in First National Bank, Malden, Mass.

PERMANENT FUND

Deposit, Melrose Savings Bank, December 4, 1923	$1293.33	
Interest on deposits, November 29, 1924	45.21	
Interest on Liberty Bonds	34.00	
Part payment on Liberty Bond		$599.46
Balance, Melrose Savings Bank, November 29, 1924		773.08
	$1372.54	$1372.54
Deposit, Melrose Savings Bank, Melrose, Mass., November 29, 1924	$773.08	
4¼% Liberty Bonds	1600.00	
GRAND TOTAL	$2373.08	

SUMMARY

Balance in Index I account, November 29, 1924	$543.73
Balance in Index II account, November 29, 1924	13.64
Balance in Journal account, November 29, 1924	2687.39
Balance in Association account, November 29, 1924	987.02
GRAND TOTAL	$4231.78

Respectfully submitted,
C. W. COLLINS, *Secretary*

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: At the last annual meeting the present President was continued as Business Manager of the JOURNAL and therefore in that capacity I will read a brief statement in regard to the JOURNAL.

REPORT OF BUSINESS MANAGER
of the
JOURNAL OF ECONOMIC ENTOMOLOGY

At the last annual meeting of the Association a new Secretary was elected, and inasmuch as the writer was continued as Business Manager of the JOURNAL, it seems necessary to make a separate report.

The Index of American Economic Entomology which was published under the direction of the Editorial Board of the JOURNAL, has also been handled by the Business Manager.

In order to obviate the necessity of opening a separate set of books the funds have been turned over to the Secretary of the Association, and an accounting will be found in his annual report.

JOURNAL OF ECONOMIC ENTOMOLOGY

The volume of the JOURNAL for 1924 contains 693 printed pages. This is an increase of 125 pages over the volume for the previous year. There has been an increase in the number of subscribers throughout the year and this has helped materially in building up the finances of the JOURNAL and making possible the increase in the number of pages. A substantial balance is now in the treasury and it should be possible to considerably increase the size of the volume for the coming year. Back numbers of most of the volumes are available, but in a few cases the supply is becoming depleted and the prices have been increased. During the past year we have received a small number of duplicate copies of Volume 1, No. 2, which made it possible to make up a few complete sets of Volume 1, and these have been sold for $7, a volume. Only three complete sets of this volume are now in stock. Volumes 8 and 11 now sell for $4 each, and volume 12 for $5. All other volumes except those mentioned can be obtained for $3.50 each. On foreign orders an additional charge of 50c per volume is made to cover postage. Single numbers of Volume 1, with the exception of No. 2, can be furnished for $1 each, and single numbers of all other volumes 75c each. Members who wish to complete their sets of the JOURNAL should do so soon, as the price of some of the volumes will be increased about the first of February.

INDEX I AND II

A number of sales of these books have been made during the year. The financial statement indicates that there is a balance of $543.73 in favor of Index I. At the beginning of last year Index II still owed the Association fund $225. Sales have been sufficient during the year so that $150, of this amount has been repaid and there is a small balance in the treasury. Index II now shows a deficit of $75, which can probably be paid up during the coming year.

Index III should be published next year and the funds that have now accumulated to the credit of Index I should be used to help meet the cost of this publication.

Respectfully submitted,

A. F. BURGESS, *Business Manager.*

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: The next item of business will be a brief report by Mr. Collins as Circulation Agent of the JOURNAL.

REPORT OF CIRCULATION AGENT

Reports showing fair gains in increased numbers of subscriptions have been presented before this Association during each of the past two years. During those two years the field for new subscriptions was thought to have been well covered but during 1924 a very substantial gain of 104 new subscriptions have been recorded, making a grand total of 1124 subscriptions to our JOURNAL during the year. Urgent appeals for subscriptions have been made mostly through our state and provincial leaders, which at the time they were made in many cases were not indicative of results, but it is apparent that such efforts are still bearing fruit.

The following table shows the total domestic and foreign subscribers in 1913, 1921, 1923 and 1924:

	1913	*1921*	*1923*	*1924*		*1913*	*1921*	*1923*	*1924*
Alabama	3	7	9	10	Massachusetts	48	70	76	74
Arizona	7	5	8	8	Michigan	15	10	10	13
Arkansas	2	5	4	5	Minnesota	10	13	14	14
California	34	65	67	78	Mississippi	4	19	22	20
Colorado	7	15	12	14	Missouri	8	10	12	15
Connecticut	10	15	15	16	Montana	5	7	7	12
Delaware	3	2	3	4	Nebraska	3	4	3	3
Dist. of Col.	50	42	55	55	Nevada	1	2	2	2
Florida	7	17	15	18	New Hampshire	4	7	9	6
Georgia	6	9	10	10	New Jersey	14	22	22	27
Idaho	2	6	6	6	New Mexico	3	4	3	2
Illinois	30	25	31	29	New York	52	40	69	76
Indiana	16	13	15	13	North Carolina	6	10	8	10
Iowa	5	14	12	16	North Dakota	0	2	1	2
Kansas	16	16	16	18	Ohio	22	32	34	48
Kentucky	4	4	5	4	Oklahoma	2	4	5	5
Louisiana	12	15	17	18	Oregon	10	12	12	11
Maine	5	6	7	8	Pennsylvania	18	33	38	44
Maryland	11	8	14	14	Rhode Island	3	1	7	4

	1913	1921	1923	1924
South Carolina	4	3	2	6
South Dakota	1	2	2	2
Tennessee	6	10	11	14
Texas	16	24	21	23
Utah	8	13	9	9
Vermont	1	1	1	2
Virginia	7	14	16	18
Washington	8	12	8	9
West Virginia	5	5	5	6
Wisconsin	6	11	13	14
Wyoming	0	1	2	2
Total for U. S.	520	687	765	837

	1913	1921	1923	1924
U. S. Poss.	26			
Hawaii		10	11	10
Panama & Virgin Islands		3	2	2
Philippines		5	5	3
Porto Rico & Cuba		6	7	6
Canada	27	37	47	47
Foreign	132	148	183	219
GRAND TOTAL	705	896	1020	1124

It will be noted from this table that the gain of 104 subscriptions during 1924 came proportionately from the United States and foreign; U. S. possessions and Canada remaining about the same.

Thanks are due all leaders in the various States and in the Provinces of Canada and those members who have assisted them and we further request that they continue with renewed interest in 1925.

Respectfully Submitted,
C. W. COLLINS, *Circulation Agent.*

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: I will now read the report of the Executive Committee.

REPORT OF THE EXECUTIVE COMMITTEE

In response to an invitation extended by the Cotton States Entomologists, to attend their annual meeting at Birmingham, Alabama, January 10 to 12, 1924, the President appointed the following members to represent this Association at that gathering: E. D. Ball, Herbert Osborn and George A. Dean.

In accordance with the vote of the Association at the last annual meeting, the following committee has been appointed to Standardize Methods of Estimating Insect Abundance and Damage: J. A. Hyslop, W. E. Hinds and R. L. Webster, and a committee consisting of J. J. Davis, C. H. Kennedy and Carl J. Drake, was appointed to investigate the purchase of the William Barnes Collection of Lepidoptera.

In March 1924, the attention of the President was called by the Chairman of the Section on Apiculture, to the meeting of the International Apicultural Congress to be held in Quebec, Canada, in September 1924. This was the first meeting that the Congress had ever held in North America, and it seemed advisable for the Section to send delegates. The fee for adherence to this Congress amounted to $10.00. The Executive Committee approved the sending of delegates and the payment of the fee. R. W. Harned, Chairman of the Section, recommended the appointment of E. F. Phillips and E. E. Millen as delegates, and J. T. Hambleton and R. B. Willston as alternates. Their appointments were approved and the fee paid from the Association treasury.

In April it was impossible for our representative to the National Research Council, George A. Dean, to attend the annual meeting of that organization, and the President appointed A. L. Quaintance to act in his place at that meeting.

In the report of the committee on sectioning the Association, which was adopted at the Cincinnati meeting, suggestion was made that each branch should arrange to have at least one representative attend the annual meeting of the Association each year, and that it was desirable for the Association to have one of its officers attend each of the branch meetings annually in order to maintain closer contact.

It was the great pleasure of the President to attend the annual meeting of the Pacific Slope branch of this Association held at Stanford University, Palo Alto, California, June 25–27. This is the first time since the establishment of the branch nine years ago, that the President of the Association has attended one of its meetings. The program was carried through very successfully, and it is believed that much good resulted from this visit to the branch meeting. It is hoped that this custom will be continued annually as it will doubtless result in stimulating interest and will increase the cooperation which now exists between the entomologists of the branch and those in other parts of the country who are members of the Association.

From July 31 to August 2, the President attended the annual meeting of the Northeastern Entomologists, held in Philadelphia and vicinity. Field projects were examined in and around Riverton, New Jersey, eastern Pennsylvania, Delaware, and sections of New Jersey east of Wilmington. A very interesting and profitable meeting was held. There was a large attendance aggregating about one hundred, and the sessions were of great benefit to those who were present.

On October 30, the President attended the first annual meeting of the Connecticut Entomologists at New Haven. A well attended and enthusiastic meeting was held, representatives being present from the colleges and universities where entomology is being taught, also from the Experiment Stations and from the U. S. Bureau of Entomology.

On November 1, D. L. Van Dine who was elected at the last annual meeting to serve as a representative of this Association on the Board of Trustees of the Tropical Plant Research Foundation, resigned to accept the position of Entomologist on the staff of the Foundation. To fill the vacancy the President has appointed W. D. Hunter to serve until the annual meeting when it will be necessary to fill this office by election. The committee recommends that this position be filled for five years to conform to the regular term of the Foundation.

The Executive Committee have audited the books of the Secretary and found them to be correct, and proper endorsement has been made in the cash book.

At the 24th annual meeting held in Washington, D. C., December 27 to 29, 1911, when the ownership of the JOURNAL OF ECONOMIC ENTOMOLOGY was transferred from the Journal of Economic Entomology Publishing Company, to this Association, it was voted that, "Recognizing the arduous duties of the editor and the business manager, and the great value of their services, the editor be paid an honorarium of one hundred dollars annually, and the business manager an honorarium of one hundred dollars annually." This resolution provides no salary for the Secretary of the Association but it has been the practice to pay one-half of the amount voted to the Business Manager of the JOURNAL from the funds of the Association. Since 1911 the Association and the JOURNAL have passed through a period when costs of operation have increased enormously. The price of the JOURNAL has been moderately in-

creased, the membership of the Association has increased from 323 to 749. Conditions have been such up to within the last year or two that careful management of the finances of both the Association and the JOURNAL was necessary in order to prevent serious deficits. Happily those conditions have now passed and the JOURNAL and the Association are in good financial condition, as shown by the Secretary's report.

The Executive Committee recommends that the salary of the editor and business manager be increased to two hundred dollars each per annum, and that they be allowed the necessary expenses for clerical assistance as heretofore.

In view of the fact that the volume of business handled by the Secretary is increasing each year, and that that office is responsible for the safe management of all funds of the Association, it is recommended that the Secretary be required to give bond in such sum as may be deemed advisable by the Executive Committee, and that the expense incurred in securing the necessary bond be paid by the Association.

At the annual meeting of the Association held at Toronto, Canada, December 29 to 31, 1921, the following recommendation of the Committee on Policy was approved: "The Committee recommends to the Association that hereafter applications for membership shall be accompanied by a check for the first year's dues and for subscription to the JOURNAL." The purpose of this resolution was to make the payment of the fee necessary before an application would be considered and also to require subscription to the JOURNAL by each new member.

In practice this has resulted in considerable inconvenience, especially to persons who apply for membership during the first part of the year, as most of them expect to receive the JOURNAL immediately after sending in the fee. The object desired can be accomplished by a readjustment of the resolution above cited and it is therefore recommended that that resolution be revoked and the following rule substituted, viz: Applications for membership will be received at any time throughout the year and if the fee for dues and subscription to the JOURNAL for the year following the next annual meeting does not accompany said application, a bill covering the amount payable will be sent to the applicant by the Secretary at the usual time of forwarding bills to members. If the required payment is not made before the annual meeting the application will not be considered by the membership committee.

The Committee recommends that the Secretary be authorized to transfer from the Association and JOURNAL accounts such funds as may be necessary as a temporary loan to assist in financing another serial volume of the Index to the American Association of Economic Entomology.

A. F. BURGESS E. R. SASSCER
M. C. TANQUARY R. W. HARNED
H. S. SMITH C. W. COLLINS
Committee.

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. F. BURGESS: The next business is the report of the representative to the National Research Council.

REPORT OF THE REPRESENTATIVE TO THE NATIONAL RESEARCH COUNCIL

The annual meeting of the Division of Biology and Agriculture for the selection of officers for the ensuing year, the consideration of reports of the sub-committees and the transaction of general business, was held on April 27 in the offices of the National

Research Council, Washington, D. C. Dr. M. M. Metcalf, Biologist, Orchard Laboratory, Oberlin, Ohio, was elected chairman of the division.

The most important matters recently before the division in which the American Association of Economic Entomologists will be interested is the establishment of the Tropical Plant Research Foundation, which, as stated by the Council, "is the outcome of widespread interest in the tropics among the scientific men of the country, and who now unite in an advisory relation to support the future work of the foundation." The particular objects of the foundation are "to promote research for the advancement of knowledge of the plants and crops of the tropics; to conduct investigations in plant pathology, entomology, plant breeding, botany and forestry, horticulture and agronomy and to publish the results thereof."

The National Research Council is represented on the Board of Trustees by one member of its Division of Biology and Agriculture. The American Association of Economic Entomologists and the American Phytopathological Society each has not only one of its members on the Board of Trustees, but each society also maintains an advisory Committee whose assistance will be sought in selecting the most competent investigators for the Foundation staff or for advice in other matters where the counsel of experienced leaders is needed. The Committee on Policy of the American Association of Economic Entomologists functions in the capacity of this advisory committee. Dr. W. D. Hunter, senior entomologist, of The Bureau of Entomology has been appointed as the representative of the American Association of Economic Entomologists on the Board of Trustees. Prof. D. L. Van Dine, formerly of Pennsylvania State College, and Mr. C. F. Stahl, formerly of the Bureau of Entomology, have been appointed Entomologist and Assistant Entomologist respectively of the scientific staff.

Since the representatives of the scientific societies serve for a term of three years, and since my service in this capacity will terminate before another meeting of the Association is held, I wish to express my grateful acknowledgment of the honor of representing this association in the Division of Biology and Agriculture of the Research Council. During the entire three years that I have represented the Association on the Council, I have been much impressed not only with the earnestness and seriousness of the members of the Division of Biology and Agriculture, but also with the important constructive work accomplished and the gigantic tasks planned for the future. I feel that the Research Council is such a source of stimulation and guidance in behalf of research, and affords such an opportunity to organize the intellectual forces of all of our biologists into a movement that will have a profound influence upon the future of science and the well-being of our country, that it should continue to have the active support and cooperation of the American Association of Economic Entomologists and all kindred organizations.

GEO. A. DEAN,
Representative of the American Association of Economic Entomologists to the National Research Council.

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: The report of the Committee on Policy will now be presented.

REPORT OF THE COMMITTEE ON POLICY

The personnel of the sub-committees during the current year is as follows:

Research, Messrs. Ruggles, Newell and Swaine.
Publicity, Messrs. Burgess, Felt and Ruggles.
Insecticides and Appliances, Messrs. Parrott, Newell and Collins.
Regulatory and Control, Messrs. O'Kane, Dean and Swaine.
Technical Training, Messrs. Dean, Parrott and Collins.

It will be noted that some minor changes have been made in the fields covered by the sub-committees. These changes are believed to afford a somewhat more accurate subdivision of activities.

The principal matter brought to the attention of the Committee on Policy during the current year has been a statement from Dr. D. L. Van Dine, our first Trustee Representative of the Association on the Tropical Plant Research Foundation, transmitting a copy of the articles of incorporation together with the By-Laws which have been adopted by that board. This communication called attention to the fact that provision is specifically made for work in entomology. Our representative invited criticisms. A summary of his communication was transmitted to each member of the Committee on Policy and presumably was acceptable.

In connection with the above the committee wishes to record its gratification that such an important agency as the Tropical Plant Research Foundation has been organized, and to express the hope that it will be able to meet, to the full, the splendid opportunities in a comparatively unworked field.

The sub-Committee on Research calls attention to the following as being of particular importance.

1. The especially rich research fields in economic entomology are,—Ecology and chemistry of insecticides.
2. The present greatest need of Economic Entomology in research is more fundamental education in the sciences and languages.
3. The converting of the authorities in charge to an appreciation of the value of ecology and the chemistry of insecticides and a realization of the need of more fundamental education in the sciences and languages.
4. More cooperation among scientific workers of allied branches of science.

The Chairman of the Sub-Committee on Insecticides and Appliances has arranged through certain members of the association for special inquiries in these two fields for the purpose of ascertaining the latest developments and pointing out the more promising lines of effort. It is planned to mimeograph summaries of the information gained and to distribute it to interested members.

The Sub-Committee on Technical Training has no special contribution to offer, though it is believed that the continued emphasis of high ideals made possible by this organization is of decided benefit to general advancement along professional lines.

The substantial progress toward unifying and simplifying quarantine regulations achieved by the conference called by the Federal Horticultural Board in May 1924 is a noteworthy step in regulative work.

The necessity of close cooperation between entomologists and investigators along other lines is clearly recognized by many. One of the prime difficulties is to bring about such cooperation as will not interfere with academic freedom and yet result in the constructive teamwork necessary to the attainment of the best results. The Committee on Policy, as a group presumably representing economic entomology in its

various phases, may accomplish considerable by stressing this phase of our work and encouraging developments along these lines. It is also in a position to render services in time of need which could hardly be secured through any other agency.

Respectfully submitted,

E. P. FELT
A. F. BURGESS
GEO. A. DEAN
WILMON NEWELL
J. M. SWAINE
C. W. COLLINS
P. J. PARROTT
W. C. O'KANE
A. G. RUGGLES

Committee

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. F. BURGESS: The next is the report of the Trustees of the Crop Protection Institute.

CROP PROTECTION INSTITUTE

REPORT FOR THE YEAR 1924

BY W. C. O'KANE, *Chairman, Board of Governors*

In the year 1924 the Crop Protection Institute has completed four research projects which have been in progress for varying lengths of time.

The studies of sulphur, including both its insecticidal and its fungicidal aspects, were brought to a close with the end of the crop season of 1924. The fungicidal studies were centralized at the Missouri Botanical Garden, St. Louis, under the direction of Dr. B. M. Duggar. The investigator in charge was Dr. L. E. Tisdale. Field tests of newly developed materials were carried out at Columbia, Mo., East Lansing, Mich., and at three points in Pennsylvania, where spraying experiments were in charge of Prof. R. C. Walton. The insecticidal studies were prosecuted at Geneva, N. Y., under the direction of Prof. P. J. Parrott, and later at Yonkers, N. Y., through the cooperation of the Boyce Thompson Institute, the investigator was Dr. Albert Hartzell. Field experiments were conducted at Poughkeepsie, N. Y., by Dr. F. H. Lathrop. In addition to the bulletin already published, two others are ready for the press, including experiments with colloidal sulphur and data concerning spray injury. New materials have been devised including colloidal sulphurs, precipitated sulphurs, an emulsion in which sulphur plays a part, and a contact dust.

The studies carried out for the Phinotas Chemical Company were largely concluded in 1923, but supplementary work was done in 1924, bringing this project to a close.

The investigations of various calcium arsenates, prosecuted through funds supplied by Riches, Piver & Co., were continued in 1924 with headquarters at Geneva, N. Y., and with supplementary work in Florida and Alabama. Mr. Foster L. Gambrell was the investigator in this project.

The study of treatments of cereal seeds to control certain smuts was continued in 1924. This project is not financed by special funds, but is made possible through the cooperation of a number of plant pathologists in central and western states and in some provinces of Canada. The work has been in progress for three years and the results are now ready for publication.

The scalecide investigation, made possible through funds provided by the B. G. Pratt Company, was continued through 1924 and will be carried out for at least

another year. The headquarters of this work are at State College, Pa., under the direction of Dr. C. R. Orton and Prof. E. L. Nixon. Mr. J. W. Miller is the investigator. Studies have been carried out, also, at Amherst, Mass., under the direction of Prof. A. I. Bourne, through the coooperation of the Massachusetts Experiment Station, and in West Virginia.

Since last year the Institute has undertaken four new research projects, each financed by special funds. These are as follows:

The American Association of Nurserymen voted support for a two-year study of crown gall. Supplementary funds were supplied by the University of Wisconsin and by the Iowa State College. The work is being carried out in part at Madison, Wis., under the supervision of Dr. G. W. Keitt and in part at Ames, Iowa, under the direction of Dr. I. E. Melhus. At Madison two investigators are employed, Dr. A. J. Riker and Mr. L. W. Boyle. At Ames the investigator is Mr. J. H. Muncie. The study is planned to continue along similar lines through at least 1925.

In January 1924 work was begun on a study of furfuraldehyde, through funds provided by the Quaker Oats Company and with the cooperation of the Miner Research Laboratories, of Chicago. Mr. H. M. Flor was employed as investigator with headquarters at Ames, Iowa, under the direction of Dr. I. E. Melhus. Work has continued through the year. The purpose of this study is to discover the fungicidal properties of furfuraldehyde, commonly called furfural, a substance recoverable in large amounts from oat hulls.

With n a few weeks an agreement has been made with the Standard Oil Company, by which a two-year study will be made of a new type of spraying oil developed in their laboratories. The investigator will be employed for a minimum of two years, or possibly for an additional year. It is expected that headquarters of the work will be in one of the central states with the addition of field experiments in two or three additional states. Mr. W. P. Flint, of Illinois, is chairman of the committee in charge of this project.

An agreement has just been concluded, providing for a two-year research project in copper salts. The larger part of the funds for this are provided by the Nichols Copper Company, the Balbach Metals Corporation and the Goldsmith Bros. Smelting & Refining Company, with additional support from the Boyce Thompson Institute. It is expected that work will start within a few weeks.

The Institute retains the affiliation with the National Research Council which has prevailed in the past and which has been of great help to it in its work. Mr. Paul Moore, Secretary of the Institute, represents the National Research Council on the Board of Governors. All funds collected by the Institute are disbursed through the Bursar of the Council.

The new projects noted above, like those undertaken in prior years, are made possible through special appropriations provided by various industrial or other organizations. The money made available through these appropriations is used exclusively in carrying out the special project concerned. Each such project is made the subject of a formal agreement between the Institute and the supporting organization. The Institute has no general funds except such money as is derived from dues, which amounts to a limited and relatively small sum per annum. The generous cooperation of many entomologists and plant pathologists alone makes possible the Institute's work.

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: We will now hear the report of the Scientific Trustee, Tropical Plant Research Foundation.

REPORT OF THE SCIENTIFIC TRUSTEE, TROPICAL PLANT RESEARCH FOUNDATION

At the Cincinnati Meeting the writer presented an outline of the proposed Tropical Plant Research Foundation, organized under the auspices of the National Research Council, and requested the cooperation and active interest of this Association in the purposes and objects of this new organization. An invitation was extended for the Association to nominate one of its members to serve as one of the Scientific Trustees. The request was favorably received and the writer was nominated to represent you. The following features in the affairs of the Foundation for the past year are given for your information and consideration.

The formal organization meeting of the Tropical Plant Research Foundation was held in Washington, D. C., on April 26, 1924, and your representative was elected as one of the scientific members of the Board of Trustees. It should be explained that the Foundation is a Corporation and for legal and business reasons the Board of Trustees must be self-perpetuating, that is, must elect its own Board of Trustees or fill vacancies that may occur. To carry out the policy of obtaining representation on the Board of Trustees from certain National institutions, they were requested to nominate from their membership representatives to serve in this capacity. Other institutions having such representation on the Board of Trustees at the present time are the National Research Council and the American Phytopathological Society.

The Foundation was incorporated on June 6, 1924, under the laws of the District of Columbia governing societies for scientific and similar purposes. The Foundation has no capital stock and is not conducted for financial profit. Its particular objects are the promotion of research for the advancement of knowledge of the plants and crops of the tropics, with special reference to Tropical America, and for the study of tropical plant production problems. The work is carried out on a project basis, each undertaking to be organized around a definite problem or particular industry. It is intended to give tropical plant industries research service similar to that performed in the United States by the various agricultural research institutions.

Provision for the first project of the Foundation was completed during the year by contract with the Cuba Sugar Club, an organization of sugar-cane growers in Cuba, for work on their production problems to extend over a period of five years. The contract with the Cuba sugar-cane producers calls for investigations on sugar-cane mosaic, root diseases, insects, new resistant cane varieties and soil fertility problems.

Active work under the Cuba sugar-cane project began on November 1, 1924. Of special interest to this Association is the work under way on the transmission of sugar-cane mosaic. After consultation with the Committee on Policy of this Association and with the administrative officials of the U. S. Bureau of Entomology, Mr. C. F. Stahl of the Bureau was selected to take the responsibility of the insect phase of this problem. Mr. Stahl is now in Cuba, located at the temporary field station which has been established at Jobabo in Oriente Province. After only a month in the field, no statement will be made concerning Cuban sugar-cane insects except that a wonderful opportunity for research and for service in our subject is offered. Mention should be made of a mealy-bug which is found feeding on the roots of sugar-cane. In some districts the cane growers have recognized the insect for several years as a

serious cane pest in limited areas and it is now a matter of some concern in a number of localities. Material has been referred to Mr. Harold Morrison of the U. S. Bureau of Entomology who reports that the insect represents almost certainly an undescribed species and perhaps a new genus but can be placed tentatively as *Ripersia*. We suspect that host plants will be found among the non-economic grasses adjacent to the cane fields. Its soil habit brings our interest at once to the lines of work in progress and the methods that have been developed for treatment of soil insects. The problem is complicated by the ant associations which appear to be fixed and to be a factor in spread. From present indications, this insect problem appears to rank second to the insect phase of the work on transmission of sugar-cane mosaic.

The original request from the Foundation to this Association for cooperation was referred to your Committee on Policy and this Committee is considered to be the advisory body through which active relations with the Foundation will be maintained. Similar requests for advisory relations will be made to other National societies concerned with plant production problems. The connection in their cases, however, is expected to be made through the National Research Council and the advisory relations with the Foundation will function through the representative of the Council on the Board of Trustees. In the case of this Association, where representation occurs on the Board of Trustees, such advisory relations will be conducted through the Association representative. Definite action in the matter, however, was not taken by this Association at the Cincinnati Meeting. If the above procedure meets with the approval of the Association, it is recommended that the Committee on policy constitute the Advisory Committee of the Association to the Foundation through the Association representative on the Board of Trustees.

When the field staff for the Cuban sugar cane project was organized, your representative was offered and accepted the position of entomologist. This resulted naturally in a vacancy on the Board of Trustees and your President was requested to nominate a member to fill the position for the unexpired term. It is a pleasure to report that the nomination for the place has been accepted by one of our former Presidents, Dr. W. D. Hunter. This appointment is effective up to the annual meeting of the Board of Trustees of the Foundation in April, 1925. Action is necessary on the part of the Association at this meeting in the matter of a permanent representative as a member of the Board of Trustees. To meet the requirements of the articles of incorporation and the by laws of the Foundation, such nomination should specify a period of five years from the date of the annual meeting of the Foundation next April. We urge the continuation of your active interest in this work not only on the basis of the actual need of the Foundation for such representation from this Association but also on the grounds of the opportunity offered the Association for service in entomology in tropical America. We consider our work to be a contribution to the real needs of our own country. It is the outcome of many years of effort on the part of the scientific men of this country with tropical experience who have realized more and more the significance of tropical development and tropical production to our national life. We believe that the Foundation organization offers the opportunity to carry the benefits of research into these regions to the benefit of them and of our own needs. Our dependence upon tropical products is vital. To carry out our purpose effectively, the interest and cooperation of all lines of research concerned with plant production is needed—will we concede that any line is of more importance than the repression of plant insects?

D. L. VAN DINE,
Entomologist, Tropical Plant Research Foundation

MR. D. L. VAN DINE: The report of the Executive Committee of the Association indicated that Dr. W. D. Hunter was appointed by the President to fill the vacancy on the Board of Trustees until formal action could be taken at this meeting. This appointment was a matter of great satisfaction to our Board of Trustees.

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. F. BURGESS: The next is the report of the Representatives on the Council of the Union of American Biological Societies.

MR. A. L. QUAINTANCE: The second member of this committee, Professor Crosby, is not present and I have not been able to secure his signature on the report, although he authorized me to prepare it.

PRESIDENT A. F. BURGESS: Unless there is objection, the report will be presented as prepared.

REPORT OF THE REPRESENTATIVES ON THE COUNCIL OF THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

Your representatives attended the second meeting of the Council of the Union of American Biological Societies, which convened in Washington, December 22, 1924, and are pleased to report that most of the societies, comprising the Union, were there represented, and that distinct progress in the affairs of the Union was reported by the executive committee.

It will be recalled that in the report of this committee a year ago, it was stated that there was a difference of opinion among the delegates present at the organization meeting of the Union held in Washington, April 26, 1923, as to the advisability of publishing a single comprehensive system of abstracts and indexes for all of the biological sciences, or whether separate reports should be issued covering the work of the respective groups. The Joint Publications Committee of the Union and of the National Research Council circularized the membership of the constituent societies to obtain information on the following points:

1. Do you favor the project of publishing a single comprehensive biological abstract journal?

2. Without committing yourselves financially, is it likely that you would support such a journal by subscription?

The results of the circularization to 6,700 American biologists were published in the November 28 issue of *Science* for 1924.

Of nearly 4,500 replies received, 84.3% answered yes to question one, and 55.99% answered yes to question two. In the American Association of Economic Entomologists, 342 answered yes to question one, and 32 answered no to this question.

The committee from the results secured by this circularization concluded that a single comprehensive, well supported abstracting and indexing service for the biological sciences, would meet with the approval of the greatest number. Some 60% expressed a tentative willingness to subscribe to the journal. In addition to this referendum, similar striking approval was expressed of the plan in some 15 or 20 biological group meetings held under the auspices of the Executive Committee of the Union.

It will also be recalled that one of the important things to be worked out by the

Council of the Union, in cooperation with the Division of Biology and Agriculture of the National Research Council, was the securing of funds to support for at least a considerable period of years, the editorial service and related charges connected with this large project. The Executive Committee at their meeting Monday were able to report notable success in this particular, namely, that the Rockefeller Foundation has contributed the sum of $350,000, available over a ten year period for editorial expenses, not, however, including printing and distribution costs, which latter must be met by subscription from individual biologists and libraries. It should be emphasized that subscriptions and sales must be sufficient to carry all manufacturing and related costs connected with the issuance of the abstract journal, otherwise the service remains an impossibility. Furthermore, it is expected that by the end of the ten year period, during which the Rockefeller Foundation funds are available, the journal will have developed to a point that it will be self-supporting, that is, able to defray also part or all of the editorial costs. During the year, 1925, members of this association will be given opportunity to subscribe to the journal, which is scheduled to start with 1926, the price to be as low as is consistent with sound management and the quality of services rendered.

While a sum of $20,000 will be available for expenses during the year, 1925, the Executive Committee of the Union finds, upon careful survey of necessary expenditures, that this sum will not be sufficient by some $5,000. The Committee is therefore under the necessity of asking the constituent associations to assist if possible to make up this deficiency. The Association of Economic Entomologists, your representatives feel sure, should be willing to do its part, and it is hoped that this point may be discussed, if necessary at this time. We feel warranted in making the suggestion that if contributions were made on the basis of $1.00 per member this would adequately discharge the Association's obligations in this connection.

At the meeting of the Council Monday there was some discussion of the relation of existing abstracting and indexing services to the proposed journal of biological abstracts. In the case of numerous societies no special difficulty will be met. In the case of the Association of Economic Entomologists, it was the feeling of the Council that a committee should be appointed in the Association to work with the Joint Publications Committee of the Council and of the Division of Biology and Agriculture of the National Research Council, to properly present the needs of our Association in this abstract service. In the literature of economic entomology, for instance, there are many valuable papers on insecticides, spraying apparatus and other subjects, which might not normally be reviewed in a journal devoted to biological abstracts. It is recommended therefore that the nominating committee of this Association provide at this meeting for the desired committee.

The Executive Committee of the Union, and especially the Joint Publications Committee have accomplished a phenomenal amount of work during the last year and are to be congratulated on the success which has followed their efforts. Your representatives are convinced that this movement now so well under way, will be of the greatest advantage to working entomologists and others occupied with the biological sciences in general.

Respectfully,

A. L. QUAINTANCE
C. R. CROSBY
Committee

After a full discussion, it was voted that the report of this committee be accepted, that the part of the report referring to indexing be referred to a special committee which shall be selected by the nominating committee and that the part of the report relating to financial matters and co-operation be referred to the Executive Committee with power to solicit a contribution of $1.00 or more from each member as necessity may require.

PRESIDENT A. F. BURGESS: We will now hear the report of the Committee on Nomenclature

REPORT OF THE COMMITTEE ON NOMENCLATURE

Your Committee begs to report that in preparing the list of common names which were accepted at the last meeting with the American Association for publication, many inconsistencies in form, use of hyphens, etc., were discovered. These could not be eliminated by the rules as published in Volume 16 Number 1, of the JOURNAL of ECONOMIC ENTOMOLOGY. We, therefore, feel it advisable to recommend that the Association make the following substitution for rules Nos. 3, 4, and 7:

3. Common names are simple or compound, simple when composed of a single word, as *Dobson*, *Cadelle*, &c., for which no rules are needed, and compound when composed of two or more words, for which the following rules are proposed:

4. In all compound names there are two parts, the NOUN part, or group name, and the MODIFYING part, consisting of one or more words modifying the group name. The proper definition of the NOUN part is to be accomplished by the following rules, A to C:

   A. The last word and the preceding one is merged to form the NOUN part where for various reasons usage has already merged or is in the process of merging two words into one, as Grasshopper, Sawfly, Sowbug, &c. A list of such names is appended and others may later be added.

   B. The last word and the preceding one are united by a hyphen to form the NOUN part in the three following cases:

      1. When the preceding word denotes a natural portion of a host or food-plant of the insect concerned, as *leaf-beetle*, *root-borer*, *bud-moth*, etc.

      2. When the last word implies transitive action and the preceding one is NOT the name of an animal or plant itself, as *root-borer*, *shield-bearer*, etc. (In the above cases 1 and 2 it is to be noted that words denoting either a food-plant or its fruit, as *apple*, *cherry*, *cane*, etc., unless designated as a part of a named plant, as *raspberry cane*, are considered as representing the plant itself. Also diseased or abnormal portions of hosts or food-plants, as *scab*, *rust*, *blister*, etc., are not considered as parts of an animal or plant except galls, which are arbitrarily considered as being natural portions of plants).

      3. When the preceding word or words denote an animal or plant but NOT the host or food-plant of the insect concerned, as *Zebra-caterpillar*, *Flea-beetle*, etc. (such descriptive nouns as *Lady*, *Soldier*, etc., are considered as falling under this rule, as in *Lady-bird*, *Soldier-bug*, etc. Also names of plants when used in the sense of habitats rather than food-plants, as *Plant*, *Bush*, *Tree*, etc., in *Plant-bug*, *Bush-katydid*, *Tree-cricket*, etc.)

C. The last word is the NOUN part in all cases not covered by the previous rules, and is written alone, as *Lappet moth, Chinch bug*, etc.

7. When two distinct ideas are expressed in the MODIFYING part of the name or when these words form or are derived from a proper name they are written separately Examples: Round-head apple-tree borer, Florida red scale, New York weevil.

NOTE: Common usage is to be followed when it has served to run together certain words, as Boxwood, Sunflower, etc.

A. If any name formed according to the foregoing rules results in a name without pertinent meaning, or otherwise untenable, it is to be considered an exception and shall be corrected or, if not already firmly established in use, rejected. Thus *Banana weevil borer*, having little sense no matter how written, should be rejected, *Cabbage seed stalk-curculio*, a name which would result from applying the above rules, should be corrected under the present rule to *Cabbage seed-stalk curculio*.

LIST OF NAMES UNDER RULE A

Armyworm	Conenose	Leafhopper	Swallowtail
Bagworm	Cutworm	Mealybug	Toadbug
Bedbug	Earwig	Negrobug	Treehopper
Billbug	Froghopper	Redbug	Walkingstick
Blackfly	Fireworm	Sawfly	Waterstrider
Botfly	Grasshopper	Silkworm	Webworm
Bumblebee	Hornworm	Sowbug	Whitefly
Butterfly	Katydid	Spanworm	Wireworm
Cockroach	Lacebug	Stinkbug	

Your Committee also reports that it has the list of names in form for submittal to the printer at the present time but suggests that this list be held for the June number of the JOURNAL OF ECONOMIC ENTOMOLOGY.

Your Committee further reports that it has an additional list of names which it considers warrant adoption by this Association and suggests that a mimeographed copy of this list be sent to each member of the Association immediately following these meetings with a request that they make such changes as they think advisable on or before March 1, 1925, and that all names to which three or less objections are made be considered accepted by the Association and these so accepted names be added to the list which the Association has already accepted, and published therewith in the June number of the JOURNAL. Respectfully submitted:

DR. E. M. PATCH, *Chairman*
ARTHUR GIBSON E. P. METCALF
A. C. BAKER S. A. ROHWER
A. N. CAUDELL J. A. HYSLOP
Committee

After a general discussion, it was voted that the report be accepted and that action on the recommendations be deferred until the final business session.

PRESIDENT A. F. BURGESS: The next report will be that of the Committee on Index to Economic Entomology.

REPORT OF THE COMMITTEE ON PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

Carrying out the instructions of the last annual meeting your committee arranged with Dr. L. O. Howard, Chief of the Bureau of Entomology, for the compilation of the index for the years 1920 to 1924 inclusive, with a view of having it completed and published early in 1925.

Miss Mabel Colcord was detailed to take charge of this work as in the case of Index 2. She reports the manuscript well advanced toward early completion, and estimates that the next index will probably exceed 450 pages. Figuring on the basis of the 1915 to 1919 index, the entire expense of financing the new volume will approximate $3,000. There is available in the Index 1 fund about $550. Receipts from advanced sales should net about $1,000 which would leave a balance of $1,500 to be met from other sources. This latter, it is understood, can be secured by temporary loans from the Association and JOURNAL funds, these loans to be repaid as soon as sales permit.

It is recommended that the Editorial Board of the JOURNAL OF ECONOMIC ENTOMOLOGY be authorized in its discretion to proceed with the publication of the index; that the price of Index 3 be fixed at $6.00 domestic rate, and $6.50 foreign rate; also that the index be supplied to members of the Association at $5.00 a copy provided copies are ordered prior to the time of issue, the date to be fixed by the Editorial Board, and that all copies of this index furnished to members at the reduced rate must be paid for in cash at the time of placing the order.

In view of the fact that much of the work in connection with the preparation of the index in earlier years has been performed by members of the Editorial Board of the JOURNAL OF ECONOMIC ENTOMOLOGY and that the work can be easily continued in the future under the auspices of the board, thus saving a certain amount of machinery, it is hereby recommended that the committee on the publication of the index be discharged and that the Editorial Board be given power to submit to the Association future propositions in regard to the continuance of this undertaking.

Respectfully submitted,

E. P. FELT
A. F. BURGESS
W. E. BRITTON
W. C. O'KANE
W. E. HINDS
Committee

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. F. BURGESS: Owing to an error in making up the program, the report of the Committee on the National Museum was supposed to have been prepared by Dr. W. E. Hinds. It appears, however, that Dr. Felt is the chairman of this committee and I will ask him if he is ready to report at this time.

MR. E. P. FELT: I have not a formal report as I had expected it would be prepared by Dr. Hinds. I will say this, however, we all ought to be directly concerned in the welfare of the National Museum. I regret that much of the Museum work throughout the country is on a

very unsatisfactory basis. The compensation and facilities as pointed out by Dr. Howard in his address last night, are very largely for the men in charge of economic work. The result has been that most museum workers receive inadequate compensation and accomodations are not what they should be. In regard to the National Museum we shall visit there before the sessions close. I would like to suggest that as individuals you note the accommodations available for the Division of Insects. They are very much overcrowded. Conditions are bound to be worse as the years go on. Within five years or thereabouts, it may be almost impossible to work in the space allotted. I understand there is a prospect of the Government embarking upon a program of constructing buildings to relieve the necessity of hiring quarters. The Insect Division of the National Museum should not be overlooked in that connection.

PRESIDENT A. F. BURGESS: I think we all appreciate the truth of what Dr. Felt has said and all realize the needs of the National Museum. I hope the members will take these remarks to heart and that they will use every influence within their power to facilitate the work and increase the facilities of the National Museum and all other insect Museums as well.

The next report is by the Committee to Standardize methods of Estimating Insect Abundance and Damage.

REPORT OF THE COMMITTEE ON ESTIMATING INSECT ABUNDANCE

Your Committee begs to report that during the past year it has corresponded with many of the leading entomologists of the country, especially those who are specializing on the economic phase of some one of our more important pests, and, as a result of this correspondence, has secured statements covering the methods used in estimating the abundance from 17 of these workers dealing with 20 important species of insects. These 20 species represent 6 orders and the host relationships included cover so wide a range that they may be considered as fairly applicable to the major portion of our economic species. In nearly all of the cases considered there appears to be a fairly uniform plan of procedure and in most cases this procedure of securing data is sufficiently simple to be followed by comparatively inexperienced entomologists.

On the other hand, the compilation and interpretation of this data calls for broad training and considerable field contact with the insect in question as well as an appreciation of the purely mathematical factors which enter into the use of any statistical data. The most common procedure involves the following steps:

1. A general survey covering the area for which information is desired. Here topography, development, agricultural practice, drainage, etc., are taken into consideration.

2. As a direct result of the foregoing survey unit or test areas are chosen. These are chosen with careful regard to the following considerations:

(a) Distribution of the unit areas over the general region in order to secure a fair sample.

(b) Seasonal climatic shelter, soil, and other environmental conditions to which the insect is subjected in the various parts of its ecological complex.

(c) The natural habits of the insect in question in its several stages.

(d) The type of count that is to be taken, the area of these units depending absolutely upon this last consideration.

3. The abundance of the insect in its several stages in the unit areas. The number and periodicity of observations of the unit areas depends entirely upon the insect in question. This abundance is determined in what appear to be the most satisfactory methods by actual count and the count usually being translated into percentage of an ideal 100 per cent infestation. NOTE: This 100 per cent ideal infestation, however, is not clearly defined and probably cannot, in many cases, be defined.

4. The results of the observations are tabulated and arranged for final comparative study.

Your Committee recommends that in no case, should an estimate of the abundance of an insect be published without clearly setting forth the methods followed in obtaining this estimate. Failing this, it is quite impossible for future workers to use this information to any advantage. Counts should always be made to a definite sized unit, i. e., the number of insects per square foot or square yard of surface, the number of insects per 100 plants, the number of insects in 100 fruit, the number of insects on one inch of leaf or bark surface, etc. Counts should be made at definite intervals and the date on which the count is made carefully recorded. Counts should also be made on picked sample areas or at definite space intervals in the field, orchard or other area being estimated, for example: in examining an orchard the examiner should proceed either up every other row, diagonally across the field, to every tenth tree, or at some stated interval decided before he enters the field, in order that he may not be subjected to a bias in selecting his sample unit.

We are appending to this report a brief digest of the suggested methods of procedure. Your Committee suggests that this digest, after being reviewed and approved by the method involved, be published in connection with this report in the JOURNAL OF ECONOMIC ENTOMOLOGY.

Respectfully submitted,
J. A. HYSLOP
R. L. WEBSTER
W. E. HINDS
Committee.

The following appended data are also included in the report.

LIST OF INSECT SUBJECTS ON WHICH REPORTS WERE RECEIVED

(Grouped by Ordinal and Feeding Relationships)

Order	*Common Name*	*Feeding area, generally*
Coleoptera:	Alfalfa weevil	Foliage
	Boll weevil	Fruit: Bud to boll
	Sweet potato weevil	Roots and stems
	Bark beetles	Bark
	Japanese beetle	Roots and foliage
	Mexican bean beetle	Foliage
	Flea beetles	Foliage

Order	*Common Name*	*Feeding area, generally*
Lepidoptera:	Codling moth	Fruit
	European corn borer	Stems
	Sugar cane moth borer	Stems
	Horn worms	Foliage
	Split worm	Foliage miner
Orthoptera:	Grasshoppers	Foliage
Diptera:	Hessian fly	Stems
	Cattle grubs	Cattle bodies
	Stable fly	Blood sucking
	Horn fly	Blood sucking
Hemiptera:	Pea aphid	Foliage
	Sugar beet root louse	Roots
	Scales	Bark, fruit, and foliage
Thysanoptera:	Thrips	Foliage, flowers and fruit

ABSTRACTS OF METHODS REPORTED BY WORKERS WITH VARIOUS INSECTS

Coleoptera: Alfalfa weevil: G. I. REEVES, 575 E. 9th South St., Salt Lake City, Utah. 2/20/24.

In scouting new territory for weevil occurrence and abundance.

METHOD: Sweeping with 10-inch net; 100 sweeps in unit. Count adults and larvae. Make 1,000 sweeps without finding a specimen before concluding species does not occur. Interpretation of findings made on combined experience and knowledge of station force.

Coleoptera: Boll weevil: B. R. COAD, Tallulah, La., 2/19/24.

(See Memo Instructions, taking Infestation Counts.)

1. For pre-square determination of Number of Hibernated Weevils for Acre, or for Number of Plants per Weevil.

Consider stand, and spacing, after chopped out and record % of perfect stand. (NOTE: Perfect stand, according to recent—1924—standards would mean rows 3½ to 4 ft. apart, and plants chopped to "hoes width apart" with 1 to 3 stalks per hill. This would mean an average of about 15,000 stalks per acre on closely spaced cotton. W. E. H.)

Examine units of at least 25 ft. of row consecutively at each point, and distribute points through field so as to have usually 5 points, with 200 plants each, or 1,000 plants examined.

Record: No. of Plants examined.: No. of Weevils found.

Compute average No. of Plants per 1 hibernated Weevil.

On basis of stand, compute average No. of Weevils per acre at pre-square stage (or before breeding begins).

2. Square infestation: After breeding begins, with squares abundant. Examine 5 points, with 100 to 200 squares per point. Examine all squares as they occur on the row at examination points.

Record No. of Plants Examined: % of squares punctured; Repeat in same general areas every 4 to 7 days until squares become scarce and average less than 5 per plant. (NOTE: When weevils have punctured more than 65 to 70% of all squares, there is very little chance for any more bolls to form and mature uninfested. That point is therefore considered as the point of complete infestation. That is, the crop is prac-

tically completely destroyed after the weevils become abundant enough to puncture 70% of all squares. The actual number of weevils per acre to accomplish this will vary according to the "rate of squaring" of the plants. Ordinarily we can count an adult weevil for every 75 punctured squares found. W. E. H.)

Coleoptera: Sweet potato weevil: J. E. GRAF and M. M. HIGH, Bur. Ent. 2/29/24

In determining infestation of slips from seed bed, Examine visually for eggs. After planting: Count 100 plants per point, at 5, or more, representative points, and including especially areas exposed to infestation, as edges of field, near old fields, banks etc., and to get information re: every 10 to 20 rows, Record No. of Weevils found at each unit examined.

At harvest; examine sample lots of potatoes after they have been thoroughly cleaned. Samples represent edge, center, etc. Examine closely, cut where suspicious, use hand lens. Weigh infested and uninfested portions of samples and compute to acre basis. This gives Proportion of Crop Injured (Not abundance of weevils.)

After harvest, examine crowns of plants still left in field. Count crowns examined, and record as "Heavy, Medium, Light and Uninfested:" Heavy, when adults crawling commonly; Medium, when larvae found readily on splitting crowns; Light, when only an occasional larva or pupa is found in splitting crowns.

In banks, Infestation is "heavy," if adults are numerous; Medium, when slicing reveals only occasional stages; Light, when only feeding marks appear, with occasional stage.

Coleoptera: Bark beetles: J. M. MILLER, Northfork, Cal. 5/15/24.

Forest insect problems especially serious because of long period of development of the tree and big areas involved.

Bark beetle attacks are usually concentrated.

Loss values are estimated on basis of "board feet" in timber destroyed, with reduction in values. (This may not be a complete loss, but may force premature cutting, reduce grade, etc. W. E. H.)

Three objectives usually: 1. General estimate for owners information; 2. Survey as basis for control plans; 3. Survey as basis for scientific studies.

Foliage color changes, or defoliation, and killing, show injury.

Recent attack shown on conifers by "pitch tubes," sawdust, etc.

Work of "primary" and "secondary" species should be distinguished. General survey may be supplemented by "100% cruise" in which record of every tree is made, of sample areas, or strips. Then *ratio* of injury found on samples may be applied to larger areas.

Consider other causes of deterioration: Fungus attack, fire, etc.

Coleoptera: Japanese beetle: L. B. SMITH, Riverton, N. J. 2/15/24.

In originally infested areas: Plat area, and subdivide, numbering so that any section can be definitely located.

Sample areas, then chosen to represent all *types* of area infested.

Examine soil in sample strips 1 ft. wide, x 3 ft. long, and record all beetle stages found therein.

Make examinations in Fall and Spring especially.

Compare records in same points for succeeding years.

Spring examinations show better the number of Beetles, to expect.

On outskirt areas, sample points are chosen to give total of 3 to 5 sq. yards per acre.

Coleoptera: Mexican bean beetle: NEALE F. HOWARD, Birmingham, Ala. 2/21/24.

Measure insect abundance by injury to crop.

All stages are found on the leaves.

Counting of stages was not satisfactory method.

Better results from study of "proportion of foliage injured."

This checked better also with actual damage to the crop, and reduction in yields.

In study of numbers of beetles in hibernation,

Map areas to be studied so each subdivision can be numbered, Unit is 1 sq. ft. of ground.

All trash examined for hibernating beetles, which occur in colonies.

Then No. of Beetles per 1 sq. ft., of area can be determined, and Comparisons of data from year to year are possible.

Lepidoptera: Tobacco horn worm: A. C. MORGAN, Clarksville, Tenn.

Examine at least 10 plants in each of 5 centers (as in boll weevil).

In late June, when 10 to 15% of moths are out, 1 worm or egg per 3–4 plants indicates heavy August infestation.

In August, when most all moths are out, an average of 50 to 75 worms and eggs per 100 plants constitutes a "serious infestation."

Tobacco flea beetle:

Record not only actual No. of Beetles per Plant found, but also the position, whether on bottom or middle leaves. Damage is more serious on middle leaves. 5–10 beetles per plant is serious if extending to middle.

Record condition of growth and size of plants, as well as number of beetles found, and number of plants examined. Then compute to acre basis if desired.

Tobacco split worm is not important pest.

Lepidoptera: Codling moth: A. L. QUAINTANCE, Bur. of Entomology, Washington, 2/27/24.

Main point usually desired is a measure of damage sustained in a protected crop, as compared with unprotected areas.

Must consider many factors, as, Variety, horticultural practices, broods, geographical considerations, etc.

Population studies based on examinations of bark, etc., in hibernation period would be most useful (But he gives no suggestions for making these studies. W. E. H.).

Scale studies, on dormant trees, allow actual determinations of numbers of scales per unit examined, and comparison of unit records on treated and untreated areas.

(NOTE: I believe that J. J. Culver, Vienna, Va., has worked out practicable and definite "unit" examination methods for San Jose scale. I suggest that he be asked to outline his methods. W. E. H.)

Lepidoptera: European corn borer: D. J. CAFFREY, Arlington, Mass.

Late autumn examinations give maximum number of full-grown borers.

Larval population studies are based on close dissection of host plants.

General survey is made first, then representative areas are selected, and population on all host plants on these areas is found. These records are then comparable from year to year.

In each of these examinations from 3 to 10 fields, or gardens, per town are selected and counts distributed through each field.

In each count 10 random groups, represented by 10 stalks each, (showing conditions on border and interior rows). Or 5 points may be used with 20 stalks each.

Stalks showing infestation superficially are then examined for "Density of borer population."

Compute area covered by examination and relate records to Acre basis. Consider other host plants than corn also.

Lepidoptera: Sugar cane moth borer: T. E. HOLLOWAY and U. C. LOFTIN, U. S. D. A. Bul. 746, pp. 2–7.

Examine 100 canes at random. Count as "infested" where even 1 hole per cane appears.

100% infested stalks, means an average decrease of 1,000 lbs. sugar per acre (or ⅓ of normal yield) 50% infestation would then mean a loss of 500 lbs. sugar per acre.

(NOTE: In extreme cases every joint of the stalk may contain borers. H.)

Orthoptera: Grasshoppers: STEWART LOCKWOOD, Billings, Mont., 3/19/24.

Eggs: To estimate abundance of eggs is very important.

Must know habits of species. Consider type of soil, compactness, drainage, slope relative to sun, soil covering, etc.

Examine both favorable and unfavorable spots for oviposition.

Determine No. of Eggs per sq. ft., and % of land thus infested.

Locate these areas with legend descriptions, etc.

Egg beds may occur. In these examine 1 sq. ft. areas in representative blocks, or in strips, noting No. of eggs per unit.

Record area of bed, show zones examined, with number of eggs per square foot, for each zone, and block.

County Survey shows all areas scouted, locates areas examined and gives egg rate found.

Nymphs: Consider time of day, temperature, and light. Clear sky affects activity and visibility. Young nymphs are more sluggish in heat, and more easily visible.

Choose unit areas deliberately at random; number depending on size of field.

Use low power field glasses so that one can count easily without disturbing hoppers.

Migrating bands are measured by establishing a line and counting all that cross it, with a certain width, and for a certain longitudinal distance. Then on this unit, survey area involved and compute numbers in movement band.

Diptera: Hessian fly: W. H. LARRIMER. Jour. Econ, Ent. 17, p. 203, 1924.

Determine abundance in fall and again in spring, when most are in "flax-seed" stage.

Make 5 to 7 test sowings centering on what is considered as best date for sowing generally.

Examine samples from each sowing. Usually take 100 plants, or culms, in five random lots, with 20 each.

Examine carefully in laboratory and record: Plat and date of sowing; No. of Plants, or Culms, examined; % of plants, or culms infested.

For fly larvae: Total No.; Size; and Maximum and Average No. per plant.

For flaxseeds, Total No.; Maximum and Average No. per plant, or culm.

Diptera: Cattle grubs: F. C. BISHOPP, Dallas, Texas.

Observe number and size of grubs in backs of cattle at least three times during their season.

Examine at least 10 animals in each of 3 herds for a locality.

Be sure that grubs have not been squeezed out previously.

Determine total number, and average per animal, for each species of fly.

Select herds in representative localities and use animals of about same age.

To determine size of grubs, squeeze out at least 10 grubs from each herd.

Distinguish species and classify by age: Third stage; fourth stage (young and old); fifth stage ("young, white, light brown, dark brown, black").

Classify on basis of size and color, and to some extent on color of posterior spiracles.

Note in early season whether any grubs have matured and left host, as shown by large holes, or healing scars.

Estimate abundance of adult flies by noting "wild antics" of cattle as they seek shade, or water, for protection from flies.

Diptera: Horn flies: F. C. BISHOPP.

Abundance of adults is determined entirely by count.

Count, or estimate, according to whether less than, or more than 50 flies per animal.

In estimation, count on 6 x 6 inch areas, and estimate no. on animal on this basis.

Even estimation is difficult when numbers run above 1,000 per cow.

Number of flies varies on different animals. (Color, texture, etc., affect it).

So estimate on at least 5 animals to get an average.

Note whether any spraying has been done; character of soil, etc.

Examine 3 herds thus per locality.

Diptera: Stable fly: F. C. BISHOPP.

These are estimated, or counted, as described for horn flies, but with more attention to climatic conditions, time of day, etc.

Better avoid making examinations very early in morning, or late in evening, or when cold, or rainy.

Mallophaga: Chicken lice: F. C. BISHOPP, Dallas, Texas.

Three species to be considered and recorded separately.

Body louse; shaft louse, and head louse.

Examine at least 3 flocks per locality. Note whether any control methods have been used.

Head louse (*Menopon biseriatum*) found mostly on head and neck hackles: 8 to 10, with many eggs, considered "heavy" infestation.

Shaft louse (*M. pallidum*), on shafts of body feathers and running to body when disturbed: 1 to 3 lice per shaft, on feathers from several parts of body, considered as "heavy" infestation.

Body louse (*Lipeurus heterographus*), on body, under vent especially, 300, or more, per bird is "heavy" infestation.

Degree of infestation: Expressed as "light, moderately heavy, very heavy."

Hemiptera: Pea aphis: ROY E. CAMPBELL, Alhambra, Cal., Box 297, 2/28/24.

"No satisfactory method of measuring abundance yet found."

3/17/24. At San Jose, Cal. peas planted in rows, 30 in. apart, plants 6–8 in, high, even growth, erect.

Examine by tapping plants sharply on one side, knocking aphids to ground on other side of row, and examining measured distance, 10 ft. unit, at number of points in field.

Gave an average of 3 aphids per 10 feet of row (3/15). Determination becomes much more difficult later in season.

Hemiptera: Cotton leaf aphid (*Aphis gossypii*) B. R. COAD, Tallulah, La., 12/13/24.

We must consider three factors in estimating aphis abundance: First, percentage of plants in the field infested; second, proportion of leaves on the plant infested; third, population per leaf.

It was necessary to make at least semi-weekly examinations throughout the entire experiment, so we selected a representative series of cotton leaves showing different degrees of aphis infestation from the least to the heaviest.

These were selected arbitrarily, but represented what we consider as proportionate steps. The most severely infested was termed 100%, and of course the other extreme was absence of aphis, or 0%. The graduated steps between were valued at 10% intervals.

The leaves of a cotton plant were examined rapidly and a leaf population ratio was given based on the photograph of the leaf which seemed to most nearly represent the average of this plant, or rather the typical infested leaf of the plant. At the same time a specified number of plants was selected at several different points in the plat and the number infested with aphis was recorded on the basis of percentage. Also a representative series of these plants was examined, and the percentage of leaves infested was noted.

These three figures were then used in securing an average, which we have termed for purpose of convenience "Percentage of Aphis Infestation."

Hemiptera: Sugar beet root-louse: J. R. PARKER, Bozeman, Mont. 3/29/24.

At harvest time examined every plant and graded as:

Slightly infested, with 1–25 lice per plant,

Badly infested: root less than one-half covered with lice and secretions.

Heavily infested: with more than one-half covered with lice and secretions.

Earlier in season, recommends examination of at least 4 stations per acre, with 1 sq. meter per station (or more stations if feasible). Record number and proportion of plants infested; and degree of infestation by getting total number of larvae in the 4 (or more) stations. Then compute to acre basis.

San Jose scale: JULIAN J. CULVER, U. S. D. A., Vienna, Va.

The Method for Determining the Efficiency of Dormant Applications of Spray Materials for the Control of San Jose Scale, as used by the Entomologists of the Insecticide and Fungicide Board, Vienna, Va.

1. At time of application of sprays examine with lens or binocular, 2,000 scales from check plat. The percentage of dead scale found will give the natural mortality. Use two-year wood on apple and basal part of one-year wood on peach.

2. Make similar counts one month after application on all plats.

3. After the first brood has emerged and settled, count the newly settled scales on a given length of representative twigs of new wood from each tree. (Have been using total of 80 linear inches from plat.)

4. On peach make final count after the second brood has settled, using methods given under No. 3.

The purpose of these counts are as follows:

1. To determine the natural mortality.
2. To determine the effect of spray on hibernated scale.
3. To determine the effect of spray on first brood.
4. To determine the seasonal value of the spray on peach.

Thysanoptera: Blossom thrips (citrus): J. R. WATSON, Gainesville, Fla.

Blossom inhabiting species are estimated by examination of representative samples (numbering from 10 to 1,000 according to degree of accuracy desired) and counting all specimens, including adults and larvae present. Samples should represent both North and South sides of trees (more thrips on South sides and more in old blossoms) and taken scattered over the grove, and with reference to other sources of flower supply also. More citrus thrips are found in white than in colored flowers.

Examine each bloom carefully without disturbing it at first, to get adults before and during flight therefrom, then carefully remove petals, with stamens, and complete counts of larvae more at leisure. (Basis is then "No. per bloom".) Avoid blooms where petals have dropped.

Leaf inhabiting thrips are determined from careful counts on representative lots of leaves. Records are made for each sample, and based solely upon recent injuries. Beware of light reactions here.

Bark inhabiting thrips require close examination of every crack and cranny in the bark. Representative lots of twigs are examined. With camphor thrips, it is as well to base study on "feeding punctures" which are easier to count than the thrips.

On mangoes and avocadoes, it is better to estimate the ***proportion of leaf areas discolored*** by thrips work.

On peanuts and beans, count the insects on representative lots of leaves. Open carefully leaves not yet fully unfolded as that is where thrips are most abundant and most injurious on these plants.

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: I will now call for the report of the Committee appointed to consider the purchase of the William Barnes collection for the U. S. National Museum.

REPORT OF COMMITTEE OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS ON THE PURCHASE OF THE WILLIAM BARNES COLLECTION OF LEPIDOPTERA BY THE UNITED STATES NATIONAL MUSEUM

In compliance with a resolution passed by the American Association of Economic Entomologists at the last annual meeting in Cincinnati, Ohio, Jan. 1, 1924, to investigate the propaganda being circulated relative to the sale of the William Barnes Collection of Lepidoptera and to formulate a report relative to same, the undersigned, duly appointed by the President of the Association, hereby submit the following report:

Your committee recognizes the William Barnes Collection of Lepidoptera as one of the best in the world and that it would undoubtedly be a valuable acquisition to the United States National Museum.

Your committee recognizes the needs of the Division of Insects of the United States National Museum; that its work is essential in the study of insects of national

economic importance; and that it is conspicuously inadequately financially supported. We believe the value placed on the William Barnes Collection is evidence of the value of work such as is being done by the Division of Insects and that further funds should be available for work in caring for the valuable collections now in the Museum, for needed studies, for publication, for exploration, and for the purchase of collections. We believe that more equitable and satisfactory results will be obtainable if funds are made available for the purchase of collections and that negotiations for the purchase of all collections be in the hands of competent authorities, possibly through a committee appointed by the Chief of the Bureau of Entomology composed of members of the staff of the National Museum, entomologists of theMuseum, and outside entomologists. Such a committee would be in a position to judge the needs of the Division of Insects, and the value of the collections under consideration.

The amount which could be justified in the purchase of the William Barnes Collection of Lepidoptera can be determined only after a study of the needs of the Museum and a careful examination of the Collection by disinterested experts. Your committee therefore would go on record as opposed to the expenditure of $310,000.00 for the purchase of the William Barnes Collection until arrangements could be made for such an examination and the proposed expenditure justified.

Respectfully submitted,

J. J. DAVIS, *Chairman*
CLARENCE H. KENNEDY
CARL J. DRAKE
Committee.

Voted that the report be accepted.

PRESIDENT A. F. BURGESS: This completes the reports of standing and special committees. I would now like to compliment the chairmen of these committees for having their reports ready and presenting them promptly.

In conformity with the custom that has been established during the last 2 or 3 years, the President appointed the following committees early in October:

Nominations: L. S. McLaine, W. P. Flint, C. H. Hadley.
Resolutions: E. F. Phillips, R. W. Doane, Z. P. Metcalf.

These committees will report at the final session.

The remainder of the time of the morning session was taken up with the annual address of the President. On re-convening at 2 p. m., this address was discussed and the following motion was made and carried: That the President appoint a standing committee to act upon the suggestions given by the President in his address with regard to an endowment for the American Association of Economic Entomologists.

At the end of this session the President appointed J. S. Houser to the Resolutions Committee in place of Z. P. Metcalf who was obliged to leave early.

Final Business

The final business was transacted Saturday, January 3, 1925, at 12:15 p. m.

President A. F. Burgess: It is very gratifying to see so many members present at the final session. There are nearly 200 members here to participate in the closing business. This is probably the largest number that has ever attended a final business meeting of the Association.

The first item is the report of the committee on Resolutions.

REPORT OF COMMITTEE ON RESOLUTIONS

Resolved, That the name of the Section of Horticultural Inspection be changed to that of Section of Plant Quarantine and Inspection..

Resolved, That we express our appreciation of the facilities afforded the Association at this meeting by the authorities of the Central High School of Washington, D. C.

Resolved, That we express our thanks to the Local Committees in charge of arrangements for the Washington meeting for the entertainment which they have arranged for the members of the Association.

Resolved, That the Association express its congratulations to Prof. J. H. Comstock on the completion of his monumental work entitled "Introduction to the Study of Insects."

Respectfully submitted,
E. F. Phillips,
R. W. Doane
J. S. Houser
Committee on Resolutions

Voted that the report be adopted.

President A. F. Burgess: The next item is the report of the Committee on Membership.

REPORT OF COMMITTEE ON MEMBERSHIP

The committee on membership submits the following report:

1. It recommends for election to associate membership the following 98 persons:

E. J. Anderson	F. S. Cebollero	J. C. Elmore
H. Baker	R. Cecil	J. C. Evenden
J. A. Berly	O. M. Chance	Malitta D. Fischer
S. Blum	P. J. Chapman	W. E. Fleming
F. F. Bondy	L. R. Cody	A. C. Fleury
H. E. Bosc	A. W. Cressman	F. L. Gambrell
E. P. Breakey	M. F. Crowell	H. Gladney
S. W. Bromley	A. Dampf	W. L. Gray
A. C. Browne	E. W. Davis	W. M. Grube
H. R. Bryson	G. C. Decker	I. T. Guild
R. C. Burdette	Irene D. Dobroscky	T. T. Haack
H. G. Burt	D. Dunavan	H. C. Hallock
O. L. Cartwright	C. O. Eddy	A L. Hamner

S. W. Harman
G. A. Harris
A. S. Hassan
E. Hobbs
G. Hofer
H. Houston
E. T. Jones
F. P. Keen
R. W. Kelley
H. Knight
G. F. Knowlton
D. S. Lacroix
V. A. Little
C. Lyle
A. A. Mathewson
H. J. MacAloney
C. C. McDonnell
Alice P. MacDougall
J. A. McEvoy
J. A. McLemore
G. Merino
J. Milton
V. G. Milum
W. M. Mingee
P. R. Myers
P. R. Needham
F. A. Neill
E. Oertel
W. A. Orton
J. B. Parker
N. D. Peets
J. O. Pepper
A. L. Pierstorff
E. S. Prevost
R. C. Price
W. D. Reed
J. A. Reeves
E. A. Richmond
H. E. Roberts
R. Roberts
K. A. Salman
W. F. Schlupp
L. B. Scott
R. M. Seeley
W. F. Sellers
J. C. Shiver
G. L. Smith
F. F. Smith
M. A. Stewart
H. S. Swingle
S. Tarnok
W. A. Tippit
N. Turner
C. G. Wallace
H. H. Wedgworth
A. Weed
J. Wilcox
C. C. Wilson
L. C. Woodruff

2. The committee recommends that the following 35 associate members be transferred to active membership:

R. H. Allen
G. F. Arnold
K. W. Babcock
O. C. Bartlett
A. J. Basinger
C. C. Compton
W. C. Cook
S. E. Crumb
S. M. Dohanian
W. Downes
H. L. Fackler
R. D. Glasgow
J. I. Hambleton
J. C. Hamlin
E. A. Hartley
L. L. Huber
H. C. Huckett
J. C. Hutson
K. M. King
J. M. Langston
P. R. Lowry
J. A. Manter
H. L. McIntyre
A. C. Mason
F. M. O'Byrne
W. A. Osgood
D. D. Penny
J. M. Robinson
D. M. Rogers
Herbert Spencer
C. W. Stockwell
L. A. Strong
K. C. Sullivan
W. A. Thomas
Otis Wade

3. The committee recommends that the resignations of the following members be accepted:

A. E. Cameron, active, and the following 8 associates:
Dorris H. Blake
Ralph C. Ellis
E. H. Gibson
Elizabeth Keyes
B. P. Mann
C. L. Robinson
L. L. Spessard
J. L. Tillery

4. The committee recommends the election to foreign membership of Dr. Manuel Aullo Costilla of Madrid, Spain, Chief of the Entolomogical Service and Director of the Forest Fauna Laboratory.

5. And finally the committee recommends that the 6 active and 21 associate members who are in arrears for dues for two years past be notified that if these dues

are not paid within a reasonable time, the Secretary be instructed to drop the names of these members from the roster of this association.

Respectfully submitted,
GEORGE G. AINSLIE, *Chairman*
W. E. BRITTON
W. P. FLINT
Committee

Voted that the report be adopted and the members elected as read.

PRESIDENT A. F. BURGESS: I think it is in order to say that this is the largest number of members that has ever been elected to this Association at any one meeting and it is a source of great satisfaction that so many have become interested in the Association or its work and have signified their interest by applying for membership.

I will now call for the report of the Committee appointed to attend the annual meeting of the Southern States Entomologists held at Birmingham, Ala., last January.

REPORT OF REPRESENTATIVE AT ASSOCIATION OF SOUTHERN STATES ENTOMOLOGISTS

By HERBERT OSBORN

Members of the American Association of Economic Entomologists: It happened as a result of my migratory movements that I did not receive notice of my appointment as representative to the southern society until after the meeting was over. However, I was present at the meeting and while I might have been able to carry myself with greater dignity and consequence if I had known of my official standing, I am sure my reception would have been no more cordial or the opportunity to take part in the proceedings any better if I had been fully informed as to my part.

I found at Birmingham a group of enthusiastic, energetic entomologists, many of them members of this Association and naturally the papers and discussions were of much the same order as those we listen to here. One noticeable feature was the amount of time given to the discussion of Cotton Insects, especially the boll weevil. This was especially instructive to me since my actual contact with cotton insect work has been very limited.

My experience at the meeting emphasizes to me the advantage of regional meetings where the problems important to the region may be discussed at length. This was also supported by a later visit to the Pacific coast where I met a number of the active entomologists and had opportunity to note the problems in which they are engaged.

I was interested at Birmingham in the discussions concerning the relation of the southern society to this Association. A committee discussing this matter and in which I was invited to take part, went over at some length the advantages and objections to such affiliation but I believe they have not brought any request to this body. It seems quite evident that either formal or entirely informal methods of cooperation are very desirable. I believe the connection, however, should be of such nature as to allow the regional societies the greatest liberty in solving the problems of their territory.

I can heartily approve the plan of naming a delegate from this body to attend any of the regional meetings where such a delegate would be welcomed.

Voted that the report be accepted.

MR. WILMON NEWELL: I would like to move that the incoming President appoint a committee of one or more to attend the meeting of the Southern States Entomologists which will be held at Atlanta, Ga., February 3 to 5.

The motion was carried.

MR. J. J. DAVIS: I believe there are recommendations which were made by the Committee on Nomenclature that should be heard at this time.

After a brief discussion, it was voted that the report of the committee be accepted.

In reply to a question raised by Mr. W. C. O'Kane, it was stated by Mr. S. A. Rohwer that the acceptance of the report did not place final approval on a supplementary list of about 100 common names of insects which the committee recommended be referred to the members of the Association. It also recommended that no name on this list be adopted if there are 3 objections to it prior to the first of March.

PRESIDENT A. F. BURGESS: The next business is the nomination of JOURNAL officers by the Advisory Committee.

MR. A. C. BAKER: The Advisory Committee nominates for the ensuing year as JOURNAL officers: E. P. Felt, Editor; W. E. Britton, Associate Editor; C. W. Collins, Business Manager.

Voted that the report be adopted and the JOURNAL officers elected as read.

PRESIDENT A. F. BURGESS: Next is the report of the Committee on Nominations.

REPORT OF THE COMMITTEE ON NOMINATIONS

Your committee on nominations begs to submit the following report. They beg to state that consideration has been given to geographical position in selecting the names for the various officers in an endeavor to have representatives from all portions of the United States and Canada on the various committees. It has been necessary in some cases to select members in the vicinity of Washington for certain committees, in order that they may more easily attend meetings of organizations which meet in that city.

Your committee may have departed from the usual practice by selecting one of their members as a nominee for one of the committees. This action was taken only after careful deliberation and the nominee consented to act only after persuasion and did not vote.

NOMINATIONS

President, H. A. Gossard, Agricultural Experiment Station, Wooster, Ohio.

First Vice-President, R. N. Chapman, University of Minnesota, Minneapolis, Minnesota.

Second Vice-President, (Pacific Slope Branch), Leroy Childs, Hood River, Oregon.

Third Vice-President (Horticultural Inspection), C. H. Hadley, Bureau of Plant Industry, Harrisburg, Pa.

Fourth Vice-President (Apiculture), R. L. Webster, Agricultural College, Fargo, N. Dak.

STANDING COMMITTEES

Policy, A. F. Burgess, Melrose Highlands, Mass.

Membership, Harry S. Smith, Citrus Experiment Station, Riverside, Calif.

Advisory Board of Journal, Lawson Caesar, Ontario Agricultural College, Guelph, Ontario; Franklin Sherman, Jr., Department of Agriculture, Raleigh, N. C.

National Museum, R. W. Harned, Agricultural College, Mississippi.

Representative to National Research Council, T. J. Headlee, Agricultural Experiment Station, New Brunswick, N. J.

Councillors to American Association for Advancement of Science; Herbert Osborn, Ohio State University, Columbus, Ohio; George A. Dean, Bureau of Entomology, Washington, D. C.

Trustee for Crop Protection Institute, W. P. Flint, Urbana, Illinois.

Representatives on Council of Union of American Biological Societies, A. L. Quaintance, Washington, D. C.; C. R. Crosby, Ithaca, N. Y.

Representative on Board of Trustees of Tropical Plant Research Foundation, W. D. Hunter, Bureau of Entomology, Washington, D. C.

Advisory Committee to Union of American Biological Societies, Editorial Board of JOURNAL OF ECONOMIC ENTOMOLOGY.

Respectfully submitted,

C. H. HADLEY
W. P. FLINT
L. S. MCLAINE, *Chairman*
Committee

MR. W. E. BRITTON: I move that the Secretary be instructed to cast a ballot for the election of the officers nominated by the committee.

The motion was duly seconded. The ballot was cast and the officers named in the report were declared elected.

PRESIDENT A. F. BURGESS: It now becomes my duty to perform my last official act as President of this Association. Before doing so, I wish to thank the members for the confidence they have reposed in me, not only this year, but during the years gone by, and to assure you that my interest in this Association will not diminish as time goes on. We have at this meeting one member, a former President, who for many years has never missed a meeting. He is a man who is respected by us all. I want to ask Professor Herbert Osborn to conduct his former student, your new President, to the chair.

(Professor Osborn escorted President-Elect Gossard to the chair.,

PRESIDENT A. F. BURGESS: Professor Gossard, I am glad to greet you and hand you this gavel. You have toiled in entomology for a great

many years. This honor is deserved and I am glad to be the one to say these words to you. I hope that your work during the coming year as President of this Association will be as great a pleasure to you as the work that I have done in the past has been to me.

PRESIDENT-ELECT H. A. GOSSARD: Mr. Retiring President, Fellow Entomologists: This lightning has sort of shivered my timbers. (Laughter.) I had no lightning rod up and I didn't know that any of my friends had a rod up for me, and so I have no speech ready-made for you.

Our retiring President, in the course of his remarkable address, adverted to the fact that our society is growing to such proportions that very few of its members can longer hope to attain the honor which you have conferred upon me this morning. From some aspects, we are sorry that this is so, though we rejoice in this growth and the expansion of our numbers.

I wonder if I dare lift the curtain of the past for a few moments and reveal to you a few things that have happened in bygone years in our committee rooms.

Several years ago, I served on the Committee on Nominations. It was the year that we named for our President that remarkable man, the late lamented C. Gordon Hewitt. But, before arriving at that decision, we went checking down the membership list in order to determine who had and who had not been honored with this position. We had not proceeded far until we came to a name that stands out as a mountain peak in the progress of entomology. There was a little hurried consultation among the Committee and it was the unanimous, rather rapid, decision that the day had passed when the Committee could remedy the omissions or the neglect of the past, and that it was no longer in the power of this Association by any official act to add to the honor or the repute in which this member was held. His name upon our rolls would always be an honor to us, but we could not add to the honors that were already his; and so we left him to that lofty isolation of achievement and honor, to which or from which, this Association could neither add nor subtract.

If anyone shall think that the doors are closed against him to attain this honor, he may still feel that, in the company of a man like Comstock, he will always be in a company every whit as illustrious and in all ways as distinguished as if he had joined the goodly company of past Presidents. I fancy that if we go home to our neighbors and meet with appreciation and with honor there—honor that is deserved and earned—we are just as well off,—I dare say we are better off than if we were to receive from this Association the highest honors that it can bestow,

and yet go back to our neighbors and to the men who work at our elbows and fail to receive from them the appreciation that ought to be ours.

Mr. President, you and Dr. Howard have made my task in some ways very easy and in some ways quite difficult. You have told us of the various landmarks of achievement reached in bygone days. You have outlined a splendid program for the future. Dr. Howard has so well outlined just what we need for the coming years that I think your new President will not need to say very much about this in his Presidential address. It strikes me that you have picked out a very poor Joshua to follow such a Moses as our retiring President. (Laughter.)

I take it that this Association is on the railway tracks; you have asked me to hold the throttle of the locomotive. I shall need a mighty good stoker. I have not been so blind in years gone by as not to notice who was doing a splendid job of stoking, and I doubt if we are ready to graduate from the stoker's job, a man who has also been a Moses to point out the way for the future. I can assure our retiring President that I am sometimes hard of hearing and occasionally am afflicted with elephantiasis, or thickening of my skin, and I doubt if shouts or thumps can make me understand that he cannot keep right on stoking just as well in the future as he has in the past. He has summoned you, in a splendid way, to advance. I would be unworthy to follow in his footsteps if I did not repeat that summons.

So, brother entomologists, it is my pleasure to summon you from entertainment and refreshment to labors, and to ask you to attempt to realize the splendid ideals that our President for this year has held before us. I am very sure that all those who in the past have assumed this presidential responsibility may be depended upon for help and counsel, but I wish to say to all of you that the way to the President's office will be wide open down to the last name on our membership roll.

Since you have placed upon me the responsibility of leadership, I must ask of you that you accommodate yourselves, as far as you can, to that type of leadership which I have always practiced and by which I find I can accomplish most. I want your counsel. I want your help. I want you to say what you want done. It makes no difference whether you are a former president, whether you are an active member, or whether you are an associate member, I want your ideas.

I have wondered at times whether our associate members have a feeling that, because we do not allow them to vote and because we prohibit a few things of that kind, they are in a measure excluded from participation in our policies. If you, of the associates, have any such feeling,

just dispel it. I suspect that the doors have always been just as wide open as they are now, but if you desire a special invitation, and if you think of something that you believe will help this Association, write it to me. If you have a hobby-horse to ride, get on it and ride it down the avenue and set it up on the president's table; ask him to admire it and I promise you that he will give it respectful attention. While we, of the managing committees, may not be able to adopt all of the suggestions that come to us, we will at least listen to them.

Do you ask me whom I shall thank for this honor? I will have to go back a long way to begin expressing my thanks. I suppose that I owe some special thanks to the Committee on Nominations—I have forgotten who they are, except Mr. McLaine, but I will find out who they are since they have had the temerity to name me as your President; I certainly owe them some very direct thanks and if they have need of special protection or a bodyguard on that account at the next meeting, I will do the best I can for them. (Laughter.)

It has always been a source of satisfaction to me that, though I was among the young "hopefuls" of Professor Osborn's early days, he just went on training entomologists; he kept turning them out right along just exactly as if I hadn't been traveling on his road. He is a man of great courage and persistence. I am glad that, in spite of all discouragements and embarrassments, he can go right on educating new workers. I owe many thanks to him.

I suppose I also owe a word of thanks to those executive officers under whom I have served for many years and who have given me reasonable support, unfailing courtesy, and encouragement.

If it were possible for me to reach out and gather together all the various assistants and faithful aides who have been at my elbow for the past twenty years, and if I could just somehow resolve them into one composite man, I would know exactly to whom you should have voted this distinguished commission with which you have honored me this morning. To them, I owe, very, very much of this honor.

And now, I hope that you will not regard it as an affectation, if during the year I shall sign myself in my communications to you, as I hope to be in deed and in truth and as I now submit myself,—"your obedient servant."

Ex-President A. F. Burgess: Mr. President and Members: The President said something about elephantiasis. I imagine that has something to do with elephants. I don't know whether he was calling me an elephant or not. (Laughter) I have heard people called "whales" but I

don't know whether "elephant" applies to the same characteristics or not.

Your new President called me a Moses, I believe. (Laughter.) I never was called that before. Whether Moses would make a good stoker or not, I question. Nevertheless, I want to assure our President that I will give him any support or any help that is within my power.

PRESIDENT-ELECT H. A. GOSSARD: Is there any miscellaneous business to be transacted?

MR. W. E. BRITTON: I wish to make one more reference to that excellent address made by our retiring President. It seems to me that the historical and statistical features which it contains make it especially valuable for certain kinds of publicity work and I would like therefore to make a motion that the editorial board of the JOURNAL be authorized to print at the expense of the Association some reprints of this article, to be circulated by the Secretary for this purpose.

In explanation of this motion I might state that it is not my idea to have it sent to every member of the Association because most of them will get it in the JOURNAL anyway, but it would be extremely valuable to send to journalists and also to libraries for convenient reference in regard to the affairs of the Association and the progress of entomology in this country.

MR. E. D. BALL: I was not present at the time the address was discussed. I would like to suggest, however, that a paragraph be inserted in it calling attention to the fact that this Association was the first biological society in America that dealt directly with applied agriculture. I would like to make this as an amendment to the motion.

The amendment was accepted and the motion, as amended, was carried.

MR. R. E. CAMPBELL: The Pacific Slope Branch of this Association will hold its annual meeting at Reed College, Portland, Oregon, the latter part of next June. A cordial invitation is extended to all the members of the Association to attend this meeting.

EX-PRESIDENT A. F. BURGESS: In the past few years, very few of the entomologists from the East have attended the meetings on the Pacific Coast. I hope it will be possible for some of the members to attend the meeting next June.

MR. G. I. REEVES: I move that the Association approve the suggestion made by Professor Doane in his paper relative to stabilization of nomenclature and that the Committee on Nomenclature be asked to

follow his suggestion in so far as it finds such action is consistent with its general policy.

The motion was carried.

MR. H. B. HUNGERFORD: If I understand correctly, it is expected that this Association will meet in Kansas City next year. Lawrence, Kansas, is only 40 miles away. We are connected with Kansas City by paved roads, 3 railways, and interurban and bus lines. On behalf of the University of Kansas, I would like to extend an invitation to the members of the Association to visit the University at the time of the next annual meeting.

PRESIDENT-ELECT H. A. GOSSARD: We thank you for the information and the invitation. Doubtless many will take advantage of it.

EX-PRESIDENT A. F. BURGESS: I move that the next annual meeting of this Association be held at the same time and place as that of the American Association for the Advancement of Science.

Carried.

Thereupon the meeting adjourned at 1:30 p. m.

PART II. ADDRESSES, PAPERS AND DISCUSSIONS

Morning Session, Thursday, January 1, 1925

At the close of the morning business session, President Burgess called upon First Vice-President Harry S. Smith to preside.

FIRST VICE-PRESIDENT SMITH: We will now listen to the Annual Address of the President.

OUR ASSOCIATION

By A. F. BURGESS, *U. S. Bureau of Entomology*

ABSTRACT

The objects, purposes and accomplishments of the Association are traced since its foundation. Some of the ideals that should animate its membership, and the activities of the Organization that should be developed in the future are also mentioned.

The honor of election as President of this Association can of necessity be bestowed upon only a relatively small number of the members. Since the foundation of the Organization only one man, that staunch soldier and good citizen, and one of the most eminent entomologists that this country has produced, has been honored by election to that office on two occasions. I refer to Dr. S. A. Forbes of Illinois. The founders decreed it to be the duty of the President to prepare and deliver an address at

the annual meeting over which he presides, and in conformity with that custom it is my purpose to outline briefly some of the objects, purposes and accomplishments of this Association since its establishment.

It is with a feeling of gratitude mixed with hope that I attempt this allotted task; gratitude for the honor of holding for a brief season this high office, and hope that the facts which I bring to you may add to the development of this Association and accrue to its future benefit.

An historical account of our progress as an organization may create passing interest but if it is not the means of adding some constructive word or thought that will assist in strengthening and developing the structure that we are gradually building then its chief purpose will have failed.

More than thirty-five years ago a few enthusiastic entomologists brought forward the idea of founding this Association. Probably few of them dreamed that in the time that has since elapsed so sturdy an organization would result. At that time economic entomology was just making a beginning and its value was recognized by only a few of those who were destined to be benefited by its practice. Prior to that time most of the official entomologists were connected with the State Experiment Stations or the U. S. Department of Agriculture, hence meetings were held each year as a part of the annual meeting of the Association of Agricultural Colleges and Experiment Stations. The Entomological Club of the American Association for the advancement of Science was another organization which brought the entomologists together at stated periods. If I read correctly the motives of the leading entomologists of the eighties, there was a spirit of unrest, a desire for independence and a feeling that the importance of economic entomology justified a separate organization which would attract and hold those who had a live interest in the subject and within which could be worked out and aided the future development of the science in America. Speaking according to present day standards, the numbers were few and the influence of the science was so weak as to make the result of the experiment somewhat doubtful. But with such leaders as Riley, Fletcher, Bethune, Forbes, Howard, Webster, Osborn, Fernald, Lintner, J. B. Smith, and others, the project was launched and the results awaited.

Independence has been mentioned as one of the underlying motives for the beginning of our Organization. This was exhibited in the brief published statements of discussion of the policy and scope of the Association during the early annual meetings; and no one who personally knew the members of the early days has any doubt concerning the freedom

with which opinions were expressed and matters discussed. This characteristic has been dominant in our Association, sometimes to our disadvantage, when personal feeling was allowed to obscure the merits of the case, but in the long run for the benefit of the Organization. With the growth and increase in numbers it has been necessary for many matters to be delegated to committees but this has usually worked out to the satisfaction of the membership. Independence of thought and action is necessary in all scientific work when it does not affect the loyalty of the man to the organization by whom he is employed. This is noticeable in most States and in the Federal Service.

At the first meeting a constitution and by-laws were adopted. Since that time they have been revised once and on numerous occasions amendments have been made to take care of new conditions that have arisen or to provide for better methods of handling the problems that were presented. This has been necessary when it is remembered that in the years since its organization the membership has increased from nine who were present when the preliminary meeting was held in Toronto, Canada, in 1889, to 749, the present membership. The guiding principles have not changed and whatever success that has been secured has been due to a strict adherence to the ideas expressed in the constitution by the founders.

Let us examine the objects for which the Association was organized:—

> "(1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work in economic entomology; (2) to give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and avoid unnecessary duplication of work; (3) to suggest when possible, certain lines of investigation upon subjects of general interest; (4) to promote the study and advance the science of entomology; (5) to publish the Journal of Economic Entomology."

The first three objects are attained largely through correspondence and the holding of annual meetings which bring together the members and enables them to confer in groups that are interested in special subjects.

The object listed under caption (4) is broad in scope and has been interpreted as being the purpose of the Association to interest itself actively in any plans that will advance the study or science of entomology. This clause in the constitution does not say specifically economic entomology, and it was evidently the intention of the Association that every effort should be made to encourage all entomological effort.

The membership was confined originally, to workers in economic entomology and three classes were provided,—Active, Associate and Foreign. At the last annual meeting a provision was made for life members. This does not especially effect the other classes but gives opportunity for any members who wish to give material support to the Association to make one payment of one hundred dollars and thereafter be relieved from further payments. Every member who can afford to make this payment should become a life member as it will materially aid the finances of the Association. Foreign membership can be conferred only on entomologists residing in Foreign countries. It is honorrary and is therefore restricted to those who have performed distinguished service.

Perhaps there is no single activity of the Association that is more difficult to manage or is more misunderstood than the classes of Active and Associate members. It has been a source of much discussion both at the meetings and elsewhere for many years. The original purpose so far as can be gleamed from the reports of the early meetings was to admit the younger entomologists, particularly those that had only a few years experience or whose interest in entomology might not be permanent, to associate membership, with the idea as they developed and became more experienced and took more responsible positions they would be raised to active membership. The two classes have equal privileges except that the associate members cannot vote or hold office.

In the early years, new members were proposed from the floor, and the member bringing in the name of the applicant designating the class where the new member should be listed, and a vote was then taken by the Association. Later it became the practice for the President to appoint a committee at the meeting to consider the proposals for membership and recommend the class where the names should be listed. From time to time the Association voted, either on recommendations by this committee or as a result of motions made from the floor, that different procedure should be followed. For instance,—at one meeting it was voted that this committee which had become known as the membership committee, should each year review the list of members and recommend for promotion from associate to active membership those that the committee felt were entitled to this recognition. This involved so much work at the annual meeting that it was impossible to give the matter the thought that was necessary in order that justice might be done to all. Later the method was changed so that the committee was appointed by the President as soon as he was elected and it served during his term of

office. This was an improvement and gave the committee a better opportunity to do effective work. As the number of applications increased it was found that no uniform policy could be established if the entire personnel of the committee changed each year. At the Cleveland meeting it was voted that a standing committee on membership be elected, a member serving for three years, one member retiring annually. This has given an opportunity for more careful study to be made of the membership lists and is the most satisfactory method of handling this work that has thus far been devised. Although it may not be generally known, applicants are not always recommended by this committee for membership, and the information furnished must be sufficient to warrant a favorable report. Associate members who are negligent in paying their dues or other obligations to the Association are not considered as being in line for advancement to active membership, and on recommendation of this committee and vote of the Association, members who are in arrears are dropped from the roll without undue publicity.

As a result of the rapid growth of the Association the question of membership became acute. Two view points were under consideration by the members and although this subject was never definitely decided by the Association, the discussion of these points of view were reflected year by year in the attitude of the membership committee. The question which was of greatest importance was whether the Association should maintain the highest technical and scientific standing as a prerequisite for elegibility for active membership, or whether a more liberal attitude should be adopted. The former course would undoubtedly restrict the membership and discourage men from becoming associated with our organization who were so situated that they could never hope to meet the requirements for active membership. The attitude of the Association for the past few years has been to adopt a rather liberal policy respecting membership, and the action at the last annual meeting in refusing to amend the constitution to make more classes of members, indicates that this policy is satisfactory.

We should remember that the science of entomology, and that this Association, is only at the threshold of development, and that future progress will make the present development look insignificant. We need interested and enthusiastic members who will by their work and study assist in bringing about these developments and educate the public to a better appreciation of the importance of our science. Let us not forget, however, that numbers do not necessarily denote strength and that if we permit the undisciplined and careless to participate with us our cause may be weakened.

By intelligent and united action this Association can accomplish great achievements; without it, though backed by enormous numbers, our purposes and aims are doomed to failure.

In the heart of New York City the great metropolis of this hemisphere, stands the Grand Central Station, a monster structure, through which, during every twenty-four hours, surges a never ending stream of humanity. It is the eastern terminus of the New York Central Railway, one of the best managed and most efficient transportation systems in the United States. This corporation operates thousands of miles of trackage, controls enormous quantities of rolling stock and owns immensely valuable stations and other property in hundreds of thriving towns and cities. This investment represents in wealth, hundreds of millions of dollars. But all of this property is but a minor element when compared with the other factors that are responsible for the success of this great commercial enterprise. This fact was recognized by the late Mr. A. H. Smith, for several years President of that road and one of its most able executives, when he stated that "A railroad is 95% men and 5% rust and dust." This principle applies in all the activities of life,—without the human element, without man, all else amounts to nothing.

Our Association needs loyal and enthusiastic men to develop its work and carry forward the objects for which it stands. Let us remember that greatness or the ability to do great service or to develop and build up an institution, is not always produced by the most highly trained individual. Many of our greatest leaders and most beloved public men have had very limited opportunities for securing an education, but through association with the man who works and by understanding his problems from experience, and by hard work, constant self denial and strict attention to duty, the way was opened for advancement.

To return to the New York Central Railroad. President Smith died suddenly and it became necessary to select a successor. Although the company had on its staff hundreds, perhaps thousands of specially trained experts in all lines of railroad activity, the Board elected Mr. Patrick Crowley. Who was he? A man who had entered the service of the company when 14 years of age and after completing the 8th grade of common school. He started at five dollars a month and worked up through all the grades until he became President of the road when 57 years of age; and he occupies that position today. Members of this Association, particularly those who have been fortunate enough to secure a higher or specialized education and who have been honored by high degrees, never fail to extend the helping hand to your comrade who

has not had these advantages. There is no entomologist more worthy of your confidence than the one who, having been unable to secure collegiate technical training, is able by his own efforts, self denial and determination to master the subject, to demonstrate his ability to do high grade scientific work. A man of this type realizes and appreciates the value of college training because he has not experienced its advantages. Our members will do honor to themselves and to our organization by assisting in every way possible those members of our Association who are less fortunate than themselves.

Patrick Crowley knew his business and had the confidence of the men with whom he worked. His record showed that when he was in a position of authority the men under his charge expected and received fair treatment and no more. One of the greatest attributes of leadership is that a man possess these two sterling qualities. It matters little whether they are exercised on a small scale or with a large organization, they will never fail to secure results and cause greater interest in, and appreciation for, the work that is being undertaken. Traits of character such as those just mentioned are not confined solely to the commercial world; they are important in all lines of human endeavor. But there are other characteristics which are important.

I shall mention two instances which have come under my personal observation which illustrate traits that show the worth of the men concerned. John W. Bradley came to the Gipsy Moth Laboratory as a trained entomologist. Late one afternoon in early summer he was directed to proceed to a wooded area, a locality that he had never visited before, some sixty miles from headquarters, and make sample collections of caterpillars which were needed to check up certain parasite records. He traveled by motor-cycle and found the cart road over which it was necessary to walk two miles or more before reaching the point where the collection was to be made. Leaving the motor-cycle near the road he made haste to follow this cart road which led into an enormous swampy area. It was beginning to grow dark and after a while he was no longer able to distinguish the blaze marks on the trail and soon became lost in a maze of intersecting paths. He wandered several hours, and late at night, guided by the sound of an electric car which passed along the highway a mile or more away, succeeded in emerging from the swamp, tired, wet and spattered with mud. It was shortly after midnight. His motor-cycle had not been disturbed but the lights refused to work. Undismayed he rode it slowly to the nearest town where he was promptly held up by a policeman for operating a machine without lights. After

detailed explanations had been made he was advised where he could secure lodging. Shortly after daylight found him on his way to make the collection and before 10 o'clock that morning he delivered it at the laboratory. At any one of a dozen points on this trip there was ample opportunity to hesitate or to falter, to offer excuses or to seek the easiest way. This man did not hesitate; he knew that the collection was needed and that it was his duty to deliver it promptly and in good condition. He did not ask for explanations or to offer excuses why the work should not be undertaken at the time designated. Devotion to duty was the characteristic which guided his action. When the war broke out he did not hesitate but became an army aviator and later received his commission. He was killed on the flying field at Dayton, Ohio.

A number of years ago we had on the gipsy moth force a colored man who was a skilled mechanic. Most of the field men knew Henry Snowden. He was always cheerful, willing to help and thorough in his work. He was industrious, quiet in behavior and was respected by all who knew him. After a time he was taken sick and died quite suddenly leaving a wife and several small children with very meager resources. The funeral was held in the colored church where he had been a member. Attended by neighbors and friends together with a few of the men with whom he had worked, the pastor read and then preached from the text,—"A good name is rather to be chosen than great riches and loving favor rather than silver and gold." A more fitting text was never selected.

These are some of the prime characteristics that should animate our membership. So long as our members know their business, have the respect of their associates, show constant devotion to duty and keep their good names unblemished, their future and the future of this organization is secure. These great principles are fundamental. We may not individually or as an organization become wealthy or all powerful, but there can be no doubt as to the value of our effort or the high standard that we will maintain. We will enjoy the respect of those who are able to recognize and appreciate merit, without blare of trumpets, undue publicity or special propaganda. The people of this country who eventually receive the benefit of the discoveries that are made by this organization and its members, will understand the importance of our work, and it will be given increased recognition. Our younger members who will in due season be called upon to carry forward, not backward, the work of this organization, should never lose sight of these great principles.

I have discussed the subject of membership in some detail. It is vital to our organization.

The fifth object of the Association as set forth in the constitution is to publish the JOURNAL OF ECONOMIC ENTOMOLOGY. . This item was not in the original constitution. From 1889 to 1895 the reports of the meetings were published in *Insect Life*, by the U. S. Department of Agriculture. From 1896 to 1907 they were published annually as a bulletin of the U. S. Bureau of Entomology. At the Chicago meeting held in December 27–28, 1907, a number of members founded the Journal of Economic Entomology Publishing Company. Arrangements were made for this company to publish the JOURNAL OF ECONOMIC ENTOMOLOGY and it became the official organ of this Association. For several years previous there had been considerable delay in publishing the proceedings as a bulletin of the Bureau, and during the last year or two that this arrangement was in effect it was necessary to reduce the number of pages of printed matter in order to comply with the Government rules concerning the relation to the number of pages to the size of the edition. The Association also faced the possibility of having to secure the publication of its reports elsewhere and the time seemed to have arrived when an attempt should be made to start an independent publication.

We are under many obligations to the U. S. Department of Agriculture and to the Bureau of Entomology, and particularly to the late Dr. C. V. Riley and to Dr. Howard, who made possible the publication of the reports for the first 18 years of our existence, and at a time when such help was vital to the success of the organization. The publishing company was organized largely through the efforts of Professor E. Dwight Sanderson, and the launching of the JOURNAL met with a hearty response. The officers were E. P. Felt, editor, E. D. Sanderson, business manager, and Wilmon Newell was advertising manager during the first two years. To these men were due the success of this venture. The business manager and advertising manager toiled earnestly to keep the finances in shape and Dr. Felt was on the job as editor, which position he still holds. I hope there will not a member of the Association leave the meeting without expressing to Dr. Felt hearty appreciation for the great work that he has done as editor of the JOURNAL during the past 17 years. The writer was the associate editor when the JOURNAL was launched and was in a position where he could observe how hard the others worked. At the 24th annual meeting held in December 1911, at Washington, D. C., it was found that the Publishing Company had been able during the four years of its existence to meet all of its obligations and the success of the project was assured. The proposal was made by the company that all its affairs be turned over to the Association. After

due consideration this was done and since that time the JOURNAL has been owned and managed by the Association. During the World War and for a time thereafter the financial condition of the publication was not entirely satisfactory due to an attempt to keep the subscription price at a low level in the face of increasing costs, and a decreasing number of subscribers. At the time of the Baltimore meeting, December, 1918, a number of members paid in funds as loans to help out the treasury rather than to have the size of the publication reduced. It was necessary also to draw on the Association funds to assist in the financing. Since that time conditions have improved. The subscription list has increased, and due to a slight advance in rates the JOURNAL is in sound financial condition. Every dollar borrowed has been repaid and for the last two years there has been a net increase of nearly 250 printed pages. The future of the publication looks very bright.

At the Cleveland meeting in 1913, the question was raised by Mr. R. L. Webster in regard to taking some action that would assure the assembling and publication of the bibliography of Economic Entomology to continue the earlier volumes issued by Henshaw and by Banks. This matter was considered by a special committee and at later meetings reports were made. A number of difficulties had to be overcome and as it was found impossible to induce any department or institution to print the bibliography, the Association decided to publish the work for the decade, 1905–1912. The manuscript was prepared by Nathan Banks who was then with the Bureau of Entomology, and the book was edited and published by the Editorial Board of the JOURNAL OF ECONOMIC ENTOMOLOGY. Since that time another edition covering the period from 1915–1919 has been compiled by Miss Mabel Colcord, Librarian of the Bureau of Entomology and has been published under the same auspices. A third volume for the years 1920–1924, is now being prepared and ought to be issued during the coming year. The manuscripts were prepared by the authors in cooperation with many specialists of the Bureau, and the thanks of the Association are due to Dr. Howard for authorizing this work to be done. These indices are very valuable contributions and are a necessity to the entomologist who must consult the literature. Thus far the books have about met the cost but the sale of surplus numbers in stock should eventually yield some revenue for the publication of future numbers.

The publication activities of the Association have far exceeded the anticipation of those by whom they were started and have given this organization high scientific standing throughout the world.

The Executive Committee consists of the President, Secretary, one Vice-President at large, also a Vice-President for each branch or section, and this committee is authorized to pass on urgent matters when the Association is not in session. In recent years this committee also has audited the books of the Secretary prior to the annual meeting.

The by-laws give each member equal privileges to present papers and enter discussion at the meetings, and equal rights to the publications of the Association.

At the first annual meeting which was held in Washington in 1889, an assessment of 25c per member was voted to reimburse the Secretary for the expenses incurred in connection with the meeting. At the fifth annual meeting at Madison, Wisconsin, in 1893, a proposal was voted to have the annual dues 50c, but the records do not seem to be clear as to whether this rule was enforced. Later it became the custom to levy an assessment varying from 25c to $1.00, on the members attending the meetings, to reimburse the Secretary. This method of financing the Association continued until the New York meeting in 1906, when a by-law was passed making dues of active members $1.00 and associate members 50c.

Since that time the dues have been increased slightly so that all except the foreign members pay $1.50 annually. An extra charge is made for the JOURNAL OF ECONOMIC ENTOMOLOGY, the members receiving it for $2.50 per annum while foreign members, who are exempt from dues, are required to pay $3.00 per annum, the additional 50c covering postage. The price to non-members is $3.50 domestic and $4.00 foreign.

The expenditures of the Association have been carefully guarded and there has been accumulated and placed in the permanent fund nearly $2500.00. This has all accrued from the annual dues paid by the members since 1906.

Every Organization is known by the good that it may do to its members or to others. Some of the stepping stones that have marked our progress will be mentioned. At the first annual meeting it was voted to omit all titles of members in the published proceedings and this plan has been followed up to the present time. It indicated a desire on the part of the founders to give equality of opportunity and make no distinction based on technical degrees.

A committee to standardize common names of insects was appointed in 1900, and three years later was made a standing committee on nomenclature. This committee has done valuable work and is still active along these lines.

In 1906 certificates were issued to all foreign members and this practice is still in vogue.

The founding of the JOURNAL OF ECONOMIC ENTOMOLOGY in 1907 has already been alluded to and the publication of the Indices of Economic Entomology previously cited have been of enormous value to the membership.

At the Minneapolis meeting in 1910 it was voted to appoint a committee to consider an application from the American Association of Official Horticultural Inspectors to affiliate with the Association as a section of Horticultural Inspection. This matter was brought up at the Cleveland meeting the following year. In the mean time the newly founded Association of Apiary Inspectors asked to affiliate as a section. After careful consideration the Association voted to accept these organizations as sections.

The wisdom of this action seems apparent as it has united the entomologists in a strong organization and prevented many opportunities for misunderstanding and controversy.

At the Washington meeting in 1911 decision was made for the Association to maintain an employment bureau. This activity was continued until 1919. Many entomologists were helped to secure positions by this Bureau but in later years as the supply of entomologists has been hardly equal to the demand, the Bureau was discontinued.

Late in 1913 the Association was incorporated under the laws of the District of Columbia and all the membership were enrolled at the Atlanta meeting that year.

In the summer of 1914 a special meeting was held at Berkeley, California, also a joint session with the Pacific Slope Association of Economic Entomologists. One of the results of the meeting was the passing of a resolution by that Association asking to become a branch of this organization. A slight amendment was made to our constitution at the next regular meeting at Columbus, Ohio, and the request was granted.

The Pittsburg meeting in 1917 was held during the war and resolutions were adopted offering the services of the membership to aid this country in that great struggle.

The following year at the Baltimore meeting a committee on policy was established to be composed each year of the President, Secretary of the Association and Editor of the JOURNAL, and five members elected for five years each, one retiring each year. The resolution provided "that the duties of this committee shall be the originating and directing of all policies of the Association and its various undertakings, the formation

and fostering of great entomological policies for the profession and the working out of a more perfect coordination of scientific effort among entomologists and between entomologists and other professions." This resolution was amended at the annual meeting the following year by striking out the words, "the originating and directing of all policies of the Association and its various undertakings." The committee therefore is authorized to concern itself with the formation and fostering of great entomological policies for the profession and the working out of more perfect coordination among the entomologists and between entomologists and other professions. There has been at times misunderstanding as to the functions of this committee. Under our present arrangements the executive committee has authority to handle all executive and administrative affairs of the Association. The committee on policy deals not with internal affairs but with the policy of the Association in its relations with outside organizations and agencies. Whether this is the best form of organizing the affairs of the Association is an open question. No change should be made until the matter has been given careful thought and study. Every opportunity that this Association may have for development and growth should be utilized, and if there are means by which this can be accomplished they should be brought into play. The members should be stimulated to greater interest in the affairs of the organization and should take active part in future development. A special committee might well be selected to investigate this matter and report at a future meeting.

At the time of the St. Louis meeting in 1919, the question of salaries of entomologists was of pressing importance. Those of our members who are of a statistical turn of mind will be interested to compare present salary ranges with the salary schedule adopted at that meeting. In a general way it does not differ very materially from the classification of salaries that has been adopted since that time by the Federal Government and by many States.

An activity suggested at the Chicago meeting in 1920 by the committee on policy has benefitted many of our members and is destined to be of greater importance as time goes on. I refer to the Insect Pest Survey which has been established in the Bureau of Entomology.

At the Toronto meeting in 1921, action was taken on several important matters. The system of bookkeeping which had been in vogue for many years was adopted as the standard for the future, and the policy of each activity being managed on a self-supporting basis was endorsed. This simply means that the funds secured from dues should be sufficient

to finance the affairs of the Association, while the receipts for the JOURNAL and the volumes of the INDEX should be such as to make these activities pay their own way.

Another forward step was the establishment of a permanent fund. This fund is gradually growing and its increase should be encouraged in every way possible.

In order to stimulate interest and increase the mailing list of the JOURNAL authority was granted for the editorial board to appoint a circulation agent. The good results that have been accomplished in increasing the number of subscribers since that time shows the wisdom of this action.

The Toronto meeting was the first one that this Association had held in Canada since the preliminary meeting was called together in 1889 for the organization of this Association by the late Dr. James Fletcher. The dinner held at that meeting deserves more than passing mention. President Dean introduced Dr. W. E. Britton one of our most respected past presidents to preside; Dr. L. O. Howard, Professor Herbert Osborn and Professor J. H. Comstock gave interesting and reminiscent remarks, and Professors Caesar and Gibson responded for our Canadian membership in a most pleasing manner. At this meeting all the past presidents were presented with a diploma which had been authorized at a previous meeting. This gathering in Toronto marked an epoch in the progress of our Association and emphasized the cordial relations existing between the Canadian entomologists and those in the United States.

At the Cincinnati meeting in 1923, the constitution was amended and provision made for life members, and it was voted that all funds received for such membership should be deposited in the permanent fund. The procedure to be followed in forming future branches was adopted after report by a special committee.

Another important matter which is likely to greatly benefit the organization and its membership resulted from a resolution that was adopted indicating that some officer of the Association should attend the meeting of each branch annually, and the desire was expressed that all branches should have some representative present at the annual meeting. The value of this contact cannot be overestimated.

I have summarized briefly what seemed to me to be the important developments that have taken place for the benefit of the Association and its membership. No mention has been made of details no matter how important, or of the work of any committees that have been of a more or less temporary nature. It has been the policy of the Association

to work for the most part through special or standing committees and after such committees have served the purpose for which they were created and the objects had been accomplished they have been discontinued. Our efforts in building up this Association have met with great success. No member can view the business proceedings since our founding without being impressed with the steady growth and the substantial progress that has been made all along the line. Many improvements have constantly been made. Few serious errors have resulted. The establishment of the JOURNAL OF ECONOMIC ENTOMOLOGY and the publication of the Indices of Economic Entomology by an organization of our size and financial strength reflect credit on the membership and will stand comparison with the activities of most scientific organizations.

The building up of our Association and the help and benefit that has been derived by our membership is however, the smallest achievement that this Association has contributed to economic entomology. From the beginning the fact has never been lost sight of that our utmost efforts should be exerted to solve the problems of economic entomology, both large and small, for the benefit of the farmer and for all the people.

At the first meetings discussions were in order looking toward better methods and more effective remedies to check the damage caused by injurious insects. These matters were considered from year to year and no one is able to appraise the far reaching benefit that was the result of the conferences held by the earlier workers. The question of insecticides and the machinery for their application became serious as it was demonstrated that spraying for various insects was an effective remedy. This resulted in numerous cases of worthless materials being sold under misrepresentation which caused great losses to the purchasers. At the Philadelphia meeting in 1904 a committee was appointed to take up the matter of testing proprietory insecticides with the view of finding some means of eliminating fradulent sales. Considerable work was done on the problem, it was determined however that the surest method of bringing about uniformity was the passage of Federal legislation requiring branding and regulating the sale of insecticides and fungicides going into interstate commerce. This Association by a special committee stood squarely behind and took aggressive leadership in pushing the Federal Insecticide and Fungicide law, which was passed in 1910. The value of this work cannot be estimated for it is surely the means of protecting countless individuals annually from purchasing fraudulent and worthless insecticides.

At the New Orleans meeting in 1905, serious consideration was given

to the matter of natural control of introduced insects and a committee was appointed to consider this matter and make recommendations as to what could be done to further safeguard uninfested portions of the United States from serious foreign insects that had become established and to prevent others from gaining entrance. Work along these lines had been carried on for a number of years by the American Association of Official Horticultural Inspectors. Many of our members belonged to this organization and were actively interested in the work. The action taken resulted in attempts by this Association and the Horticultural Inspectors Association to secure National legislation regulating the interstate shipment of nursery stock and the importation of plants and plant products from foreign countries. The Association stood squarely behind this program and there was little division among the members as to the wisdom of such legislation. Time was required however, and many obstacles had to be overcome. It was necessary to secure the co-operation of other scientific organizations and of the horticultural interests of the country. The legislation desired by the Association was not enacted by Congress insofar as control of interstate movement of nursery stock was concerned. This involved uniform inspection and certification. But the passage of the Plant Quarantine Act in 1912 which created the Federal Horticultural Board was a great step in the right direction and gave authority for the regulation of imports and the handling of domestic and foreign quarantines to prevent unrestricted dispersion of serious insects that are not established or occur only in restricted areas in the United States. To all who had any part in bringing about the enactment of this legislation great credit is due, and most of these men were among our most active and influential members.

This Association has always endorsed every reasonable effort that has been made looking toward the control or extermination of insect pests. A glance at the resolutions passed at the annual meetings shows that it has favored every effort to restrict or eliminate insect damage and the membership either as individuals or by committees, has assisted in procuring legislation along these lines. Most of the State nursery inspection laws and legislation giving authority for State quarantines on insects, have been drawn as the result of conferences on the subject by members of this organization.

Our relations with kindred societies have always been amicable. We are under great obligation to the American Association for the Advancement of Science, for the many courtesies shown and the assistance rendered in making our meetings a success. This uniform help and con-

sideration has been given since our organization began and has been a source of great benefit. From time to time joint meetings or sessions have been held with other organizations having common problems. When the National Research Council was organized this Association was asked to appoint a member to represent it in a division of Biology and Agriculture. The request was cheerfully complied with. The Crop Protection Institute which was organized under the direction of the National Research Council and which contains scientific and industrial members, was approved by the Association at the Chicago meeting in 1920, and three representatives of this Association serve on its board of trustees. At the Boston meeting in 1922, we voted to join the Union of Biological Societies, and two representatives were appointed to serve on its council. At the Cincinnati meeting last year the Association voted to endorse the organization of the Tropical Plant Research Foundation and elected one member to represent it on the board of trustees.

All these activities show that the Association is making a healthy growth and has had a creditable past.

Attention is directed to the fact that this Association is by far the oldest American scientific society affiliated with agriculture. It is true that the Association of Official Agricultural Chemists was organized five years earlier but they have always limited their field to the analysis of such things as foods, feeds, and fertilizers, and have considered research problems out of their scope. The American Society of Agronomy was organized in 1907, the Phytopathologists in 1909, while the Society for the Promotion of Horticultural Science and the Society for Animal Nutrition soon followed. Thus it will be seen that the Entomologists organized and were working in cooperation for the benefit of agriculture nearly twenty years before any other existing society with similar purposes was formed.

But organizations, like individuals, can not grow and flourish on noble ancestry or reminiscences of the past. We must go forward or backward. There is no happy medium where we can rest content on our laurels for the world will continue to move forward.

What then is the duty of this organization and in what direction should it set its face toward the future?

First it should put its house in order and make any improvements that may be necessary in carrying forward its work. No effort should be spared to vigorously push our science along all the lines that will increase its usefulness to mankind. If we are to succeed our efforts must be backed by merit. Dr. Howard has publicly stated on many occasions

that all entomology is economic. Let us adopt this standard for our guidance and lose no opportunity to add to the development of our science in every way.

The Association should stand behind every effort that is made to extend the usefulness of entomology. It should encourage every agency that is engaged in teaching or training the young for service in this profession. It should cooperate with kindred societies to promote harmony and increase mutual confidence. It should urge the necessity of the development of research in order that by a better understanding of the mysteries of life which surround us we may be able to do more to increase the happiness and prosperity of mankind.

This organization should maintain closer touch with the entomological problems of the various States and countries of the world and develop its activities so that it may become a great clearing house for the benefit of all its membership. While it should not attempt to dictate as to National entomological policies, it should maintain a vital and continuing interest in the Bureau of Entomology, the Division of Insects of the U. S. National Museum and the Federal Horticultural Board. These great National activities touch in a very vital way every working entomologist. They are an essential part of the entomological activities of this country. Without them few of the State units could function with great efficiency. It should be our aim to give these institutions our support, to watch their progress with zealous care and be ready to offer kindly words of council to aid in solving the difficult questions that are constantly being encountered. Every member of this Association should remember that these institutions are the representatives of America and that in the final analysis American progress is judged in other lands by the excellency of their work and the achievements that they accomplish.

This Association should do more than ever before in carrying forward its mission. I once heard one of our members say that the entomologists could accomplish almost anything they might undertake if they would only agree. There is much truth in this statement and it is worthy of careful thought. Let us have harmony of action and without surrendering our right to independent thought be willing to drop minor differences of opinion and earnestly support the efforts that are being made to solve the many great problems that perplex us. The basis upon which this harmony of action must be built is confidence. Confidence in the fairness and justice of our attitude towards ourself and towards each other and confidence in the integrity of our fellows. With it we shall

have the faith that will remove mountains, without it we shall struggle blindly and accomplish little.

This Association has passed through thirty-five years of creditable and useful service. Greater possibilities lie beyond. We should be awake to grasp the opportunities that come and develop them to the greatest possible extent.

The membership has grown steadily and is destined to increase more rapidly. The publication activities must be expanded to meet growing needs. Already the Secretary and the Editor of the JOURNAL are called upon to devote more of their time to this organization than can be reasonably expected. It will soon be necessary to find means whereby permanent headquarters can be maintained. We should anticipate this need and make preparation for this condition which is bound to come.

Our permanent fund should be held intact and more funds added as rapidly as possible. We will need a fund of several hundred thousand dollars to give this Association the income that will be required in a few years to properly maintain headquarters and expand the work.

The project of building up an endowment should be started at once. There is no time to lose. A special committee should be appointed to take this matter in charge. In the meantime many of the members can assist by becoming life members of the Association.

On April 22, 1924, a small party of officials proceeded from Madrid, Spain, to Villaneuva de Cordoba, where they were greeted by the entire population. The next morning a special town meeting was held and the town clerk read the minutes of the preceding meeting wherein "The selectmen of the town of Villaneuva de Cordoba, in executive session assembled, unanimously vote to adopt as 'native sons,' in appreciation of their untiring and ceaseless efforts to defend our forests against the pest, *Lymantria dispar*, the following distinguished gentlemen, Sen. D. Andres Armenteras, First Assistant Secretary of Agriculture, Sen. D. Manuel Aullo, Chief Entomologist, Don Angel Riesgo, Assistant Entomologist in charge of Laboratory and Operations in the District of Villaneuva de Cordoba." Then appropriately decorated and engraved parchments were presented to each of the above mentioned gentlemen. That evening the same party was escorted to one of the town squares, where Dr. Manuel Aullo was publicly honored by having this square named "Plaza de Manuel Aullo" in recognition of the valiant fight the Chief Entomologist of Spain is waging against "the pest" (*L. dispar*) which is seriously threatening the chief industry of this region. A tablet bearing the inscription "Plaza de Manuel Aullo" was unveiled,

following a speech by the Assistant Secretary of Agriculture. The document officially naming the square was signed by 25 of those present, including Mr. S. M. Dohanian, the representative of the U. S. Bureau of Entomology. The guests were given a banquet where prepared speeches were made expressing the appreciation of the effective work done by Dr. Aullo for the benefit of the people of that section.

For several seasons the oak forests had been defoliated by the gipsy moth so that no acorns were produced, and, as these are the principal food for hogs, the live stock industry and prosperity of the people was threatened. The application of control measures formulated by the Government entomologist reduced the gipsy moth infestation so that acorns continued to be produced by the trees and live stock industry was saved. The great interest taken by the people in this public demonstration indicated their appreciation of the efforts of the entomologists.

What has America done to recognize in any substantial way the enormous savings that have resulted from the discoveries made by the entomologists in this country? We hear of monuments being erected to the cotton boll weevil as a memorial to this "blessing in disguise," but few substantial tokens have been accorded to the entomologists who have given their best efforts to protect agriculture and industry from insect foes. And yet, there is not a more generous or appreciative people than our own Americans.

Let us not forget the lesson from Spain nor fail at suitable times to remind the public that the work of the entomologists should not go unrecognized. Many millions are given annually in this country to institutions of all kinds. No better recognition of the value of economic entomology would be possible than to have some such contributions placed in the permanent fund of this Association.

It is doubtful whether any member or small group of members can accomplish this purpose but with the earnest and united support of the entire membership this result can be obtained.

During the time that I have been connected with this organization I have always been impressed with the loyalty and whole hearted support of the members. This condition is true throughout the nation, among our neighbors in Canada and Mexico as well as across the seas. It is a credit to the organization and to the membership alike and augers well for substantial achievements in the future.

The discussion of the President's address was postponed from the morning session.

Afternoon Session, Thursday, Jan. 1, 1925

President Burgess called upon First Vice-President Harry S. Smith to preside.

FIRST VICE-PRESIDENT HARRY S. SMITH: We will now take up the discussion of the Presidential address.

MR. E. P. FELT: I wish in connection with the address of the President to call attention to the fact that probably no other member of the Association could give such a remarkable digest of our activities. It is a real contribution to the entomological history of the country.

I wish also to call attention to the fact that the President in giving us this admirable account respecting the activities of this Association has in reality been indicating in a general way the progress of an organization in which he has had a most intimate and influential part. For about twenty years that gentleman has been Secretary of this Association. He has been the counsellor of, I might say, every member of the Association. He has suggested to president after president the appointment of this committee, the adjustment of that affair, and so forth, and in a way, while this is a record of the achievements of the Association, the progress which has been made in the last twenty years at least is a fine tribute to the activity and the industry of our former Secretary, now our beloved and honored President.

Allow me to compliment the President on his good judgment of railroads. I come from New York State and, gentleman, if you want to travel on a first class railroad, take the New York Central! (Laughter).

MR. W. E. BRITTON: Mr. President, in any kind of business or organization it is profitable occasionally to take inventory or account of stock. President Burgess has done this in a most excellent way. He has given a history and summary of all the activities of the American Association of Economic Entomologists and I shall be very glad to have it all in printed form for reference.

Our President is a modest man. He has already stated that he had been in position to see others work. Some of the others have been in a position, at least part of the time, to see what he has done, and I wish to thank him personally and also to congratulate the Association on his long period of service in its behalf. To him probably more than to any other man goes the credit for a large portion of the success of the organization.

MR. L. O. HOWARD: I wish to tell President Burgess that I am extremely sorry I was not present this morning. Therefore, I am not competent to discuss his paper, but he and many of you will be interested

to get one particular slant on his address that you probably will not get otherwise. As I came in here this afternoon I met man after man who came up to me and said, "I congratulate you on that admirable address of yours last night *but you ought to have heard Burgess this morning!*" (Laughter).

MR. H. A. GOSSARD: The President in his address this morning not only gave us an outline of the more salient points of the progress in our history but took a long look into the future. Some of the concrete suggestions that he made this morning required courage on his part.

I am quite sure that many of the members of the Association were extremely glad to have that call to advance and certainly the ideals that he held out—the ethical ideals of faithfulness in work, were as good as we could expect from anybody. We all felt that it was one of the outstanding addresses that we as members of this Association have been privileged to listen to in many years.

(At this point Mr. T. B. Symons offered a motion which appears in the Business Proceedings, Part I, Thursday morning Session, January 1, 1925.)

MR. T. B. SYMONS: I believe that would be the most helpful work that the Association could engage in and it would carry on the far-reaching thought of the President in directing the work of the Association for the future. I believe that a standing committee whose duty it will be to have in mind the solicitation of and helpfulness in developing an endowment fund for the Association will be a lasting benefit, not to say a fitting memorial to the President.

CHAIRMAN HARRY S. SMITH: I am sure the remarks of these gentlemen simply echo the sentiments of every entomologist in the American Association. We all owe President Burgess a very great debt of gratitude not only for the excellent work which he has done in connection with the management of the JOURNAL but for his general attitude toward the Association and his great helpfulness at all times.

If there is no further discussion I will now turn the meeting over to the President.

President A. F. Burgess resumed the chair.

PRESIDENT A. F. BURGESS: Members of the Association, I wish to express my thanks for the remarks that have been made. I assure you they are greatly appreciated.

The first paper will be by Mr. Hyslop on "The Chinch Bug and the Weather."

THE CHINCH BUG AND THE WEATHER

By J. A. HYSLOP, *Washington, D. C.*

(Withdrawn for publication elsewhere)

MR. R. N. CHAPMAN: I would like to ask Mr. Hyslop two questions. These rectangles that were plotted were plotted before you made your correlations as I understand.

MR. J. A. HYSLOP: Yes.

MR. R. N. CHAPMAN: Why do you employ the right angle rectangle for the two extremes? I should think the polygon would be better. Then it would taper toward each end, and it seems to me would give a truer value as the extremes occurred.

MR. J. A. HYSLOP: I believe that is true, but we found so many factors were to be weighted that it was a difficult job to arrange these polygons so they would be comparable.

MR. R. N. CHAPMAN: I wanted to ask also with regard to the correlations, whether you are going to use multiple correlations for the factors involved, that is, your moisture and temperature, and then when you get them, how you are going to take care of the relative importance of weighting.

MR. J. A. HYSLOP: We will, of course, run a simple correlation; then by taking the highest correlations as indicated we will run the multiple correlation. We haven't come to weighting yet.

MR. R. N. CHAPMAN: I thought you had some method of weighting.

MR. J. A. HYSLOP: The degree of correlation as it is plotted by months will indicate the season when there is the greatest effect of weight. You see, it is a monthly plotting.

PRESIDENT A. F. BURGESS: The next paper is by J. W. McColloch.

THE HESSIAN FLY PROBLEM IN KANSAS[1]

By J. W. MCCOLLOCH, *Kansas State Agricultural College and Experiment Station*

ABSTRACT

This paper is a consideration of the Hessian fly (*Phytophaga destructor* Say) problem in relation to the wheat industry of Kansas. Emphasis is placed on the fact that the Hessian fly is only one factor in the production of wheat. The study of this insect and its control is influenced by many factors, such as wheat acreage, agricultural practices, varieties of wheat, climatic conditions, etc. The problem extends beyond the realm of entomology and calls for cooperation with other sciences, and especially with agronomy.

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[1]Contribution No. 345, from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 8 Hatch of the Agricultural Experiment Station.

Kansas is recognized as one of the greatest wheat producing areas in the United States. Approximately 11,000,000 acres are planted to this crop each year. The acre yield of the state, however, is comparatively low and one of the problems of the Kansas Agricultural Experiment Station has been to develop a system of agriculture which will enable the farmers to produce more wheat without increasing the acreage. The purpose of this paper is a consideration of the Hessian fly problem in relation to the wheat industry of the state.

The Hessian fly is only one factor influencing the production of wheat in Kansas. Bainer[2] has shown that while the average annual yield of wheat in the state for the ten-year-period, 1912 to 1921, was 109,000,000 bushels, the potential yield was 211,000,000 bushels. This is brought out in the following table which shows the more important leaks in Kansas wheat production:

Annual loss through poor yielding varieties	31,000,000 bushels
Annual loss from poor seedbed preparation	28,000.000 "
Annual loss through depleted soil fertility	30,000,000 "
Annual loss caused by insects	9,000,000 "
Annual loss caused by plant disease	4,000,000 "
Total	102,000,000 bushels

A consideration of these figures shows that the average annual loss to wheat due to insects, of which the Hessian fly is only one species, is insignificant in comparison with other factors. They serve to emphasize the point that the problem is not so much one of Hessian fly control as it is one of improved wheat production. This calls for the cooperation of various investigators interested in wheat problems in developing a system of agriculture which will tend to reduce the losses itemized above.

It is a generally accepted fact that the control of the Hessian fly is largely a matter of prevention and depends on cultural methods. Once the fly becomes established in the field, there are no remedial measures that can be applied. The opportune time, therefore, in the control of this insect in the winter wheat belt is the period between the harvesting of one crop and the planting of the next, and its control involves problems of tillage, rotation of crops, seedbed preparation, and planting. These are all agronomic problems and their application requires a thorough understanding of the fundamental principles of wheat production.

[2]Bainer, H. M. Wheat Possibilities in Kansas. 23d Bien. Rept. Kans. State Bd. Agri., pp. 153–156. 1923.

The department of entomology of the Kansas Agricultural Experiment Station has recognized the fact that in combating the fly, it was dealing with an agronomic problem, and during the past fifteen years has cooperated with the agronomy department in all investigations involving control measures. As a result of these cooperative studies, the following program is now recommended to the farmers of the state: (1) Early working of all stubble fields, (2) Proper preparation of the seedbed, (3) Destruction of all volunteer wheat, (4) Planting on the safe date, (5) Rotation of crops, and (6) Cooperation. It will be seen that this is primarily a plan for better wheat production, yet it contains the essential recommendations for controlling the fly. In presenting this program to the farmers of the state, emphasis is placed on the fact that early working of the ground, proper seedbed preparation, and destruction of volunteer wheat are the most important steps, not only for fly control, but also for maximum yields. These practices strike at the source of the infestation and the success with which they are carried out in the community determines in a large measure the subsequent infestation.

This program differs materially from the recommendations of a number of states in that in Kansas the fly-free-date is not emphasized as the most important step in the control of the fly. The principal reason for not stressing this point is the fact that even under the most favorable conditions, the fly-free-date protects against only the main fall brood. Since it does not strike at the sources of infestation, it offers no protection from the supplementary fall brood or the two spring broods. There are numerous records of serious fly damage following a campaign for late sowing, and as Drake and others[3] have pointed out, the fly has continued to be a serious pest in the Mississippi Valley, in spite of seeding on the proposed safe date.

The futility of depending on the date of planting is evident when certain points in the life economy of the fly are considered. The Hessian fly normally produces three broods a year in Kansas, and may produce five broods. No brood is complete, since all the flaxseed do not produce adults at the same time, but some always hold over. This was illustrated in 1917 when from 17 to 57 percent of the flaxseed in the stubble in Harvey, Geary, and Riley Counties, Kansas, held over until the spring of 1918. Again in the fall of 1922 there was practically a complete holdover in the stubble fields of western Kansas. Stubble fields which

[3]Drake, C. J., et al. The Importance of the Flaxseed Count in Predicting the Actual Fly-Free-Date. Jour. Econ. Ent., 17:480–486, 1924.

have been under observation have carried over some flaxseed for a period of two years. Moisture is an important factor in the life economy of the fly, and the time and amount of rainfall often determines the emergence and number of broods.

The time of planting is also an important factor in wheat production. It influences tillering, winter-killing, maturity, yield, and quality of the grain. Every delay in planting increases the danger of winter-killing and lengthens the growing period the following summer. Early maturity is important in Kansas and any delay at this time subjects the crop to injury by hot winds, chinch bugs, wheat straw worm, and rust.

It is not the purpose of the writer to question the existence of a fly-free-date, but rather to call attention to the fact that it has its limitations as a control measure against the Hessian fly. Repeated experiments have shown that the infestation by the main fall brood can be prevented by seeding on certain dates. Other experiments have also shown that there is an optimum date to plant wheat to obtain maximum yields. Frequently these dates coincide and are fairly constant. Under such circumstances, the time of planting should be emphasized in connection with the other measures. On the other hand, in areas where these dates do not coincide, or where there is considerable fluctuation in the fly-free-date, a safe date should be recommended which is the optimum time to plant wheat when all factors influenced by this operation are considered.

In conclusion, the writer wishes to emphasize the fact that the control of the Hessian fly is only one factor in wheat production. Any investigation involving control measures should be conducted in cooperation with other investigators of wheat problems. When this is done, a program for wheat improvement can be developed which has the endorsement of the entire experiment station rather than that of any one department. Such recommendations give the farmer added confidence in his experiment station, and he responds more readily to its suggestions. The program discussed in this paper is one which is recommended every year in Kansas, regardless of the Hessian fly situation. When the farmer follows these suggestions, he is practicing good agriculture, producing more wheat of better quality, and at the same time is holding the Hessian fly damage to a minimum.

MR. W. R. PROTSMAN: I would like to ask the gentleman what the production of wheat per acre is in Kansas and some of the other states.

MR. J. W. MCCOLLOCH: The average yield of wheat in Kansas is somewhere between twelve and thirteen bushels per acre. I am not familiar with any states except those right in our immediate neighborhood and I think it runs about the same there. As you go eastward the acre yield is somewhat larger than in Kansas. In most states it is probably about seventeen or eighteen bushels.

PRESIDENT A. F. BURGESS: The next paper is by C. C. Hill and H. D. Smith.

THE RELATION OF HESSIAN FLY DAMAGE TO YIELD

By C. C. HILL and H. D. SMITH, *U. S. Bureau of Entomology, Carlisle, Pa.*

ABSTRACT

This paper discusses the various ways in which the Hesssian fly (*Phytophaga destructor* Say) damages the wheat plants and reduces yield; a series of experiments is given in tabular form, showing the loss of weight per head for each additional fly larva in the culm, and a comparison is made between the weight of yield of fly free wheat and that of fly infested wheat in which all factors affecting yield other than the Hessian fly are eliminated.

A field of winter wheat may be subject to injury from the Hessian fly in the fall and again during the spring and early summer. Such injuries may embrace four distinctly different types, as follows: (1) Damage to the young plant during the fall season, (2) prevention of heading caused by the spring generation of the fly during the spring season, (3) damage near harvest time due to lodging caused by the mechanical injury to the stalk by the presence of the fly larva, and (4) loss of weight in the grain due to damage from the feeding of the larvae during the spring and early summer.

The young tillers attacked during the fall by the fly usually are killed outright, and sometimes the entire plant will succumb. At times, damage of this sort is so devastating as to completely ruin entire fields. In cases, however, of moderate infestation experiments conducted east of the Appalachian Mountains show that in these regions immediate damage is usually offset by the habits of the plant of sending up supplementary tillers. Even in such fields the presence of the fly is a potential menace by augmenting the severity of infestation caused by the spring emergence.

The second type of injury occurs during the spring season, and is the effect of the spring generation of the fly on the wheat tillers, causing them to be stunted and fail to head out. The amount of such injury is comparatively small. The percentage of tillers stunted in this way by the fly was estimated from samples of wheat stubbles collected from 98

TABLE I.—WEIGHT OF GRAIN PER WHEAT HEAD ACCORDING TO THE NUMBER OF HESSIAN FLY PUPARIA PER CULM, WITH TOTAL NUMBER OF HEADS USED IN EACH LOT, AND THE LOCALITY AND YEAR OF COLLECTION

Number of flies per culm		0		1		2		3		4	
		No. of Heads	Average Weight	No. of Heads	Average Weight	No. of Heads	Average Weight	No. of Heads	Average Weight	No. of Heads	Average Weight
Locality	Year		Ounces		Ounces		Ounces		Ounces		Ounces
Mt. Holly Springs, Pa.	1918	130	.02607	130	.02300	41	.02314	18	.02283	6	.01940
do	1919	100	.01601	98	.01144	20	.01058	7	.01083	5	.00811
Lewisburg, Pa.	1923	490	.02653	99	.02272	81	.02221	52	.02338	31	.01950
Bloomsburg, Pa., Farm No. 1.	1924	126	.02314	125	.02022	75	.02069	74	.01992	35	.01839
do Farm No. 2.	1924	92	.02392	99	.02068	75	.01883	74	.01783	69	.01447
do Farm No. 3.	1924	245	.01715	104	.01346	41	.01243	11	.01186	5	.01058
Total No. of Heads		1183		655		333		236		151	
Average Weight per Head			.02214		.01859		.01798		.01778		.01508

fields from divers localities on different years. The results showed an average of 8 per cent. of the tillers affected in this way, with a maximum of 35 per cent. and minimum of zero. Damage of this sort varies in different fields, but there seems to be no correlation between the amount of infestation and the number of tillers stunted in this manner. Samples examined from 42 fields showed an average of 14.27 per cent. of the infested tillers failed to produce heads. It would be inadvisable to place too much weight on loss of this sort because, in the first place, some of the tillers thus infested would probably have failed to head out whether fly-infested or not, and in the second place, stunting of this sort might have a pruning effect with the result of additional nourishment being sent to other parts of the plant.

The third type of injury is also due to the effects of the spring brood of the fly. The fly larvae usually lodge at the nodes near the lower part of the plants where they remain and feed. The tillers are weakened at these points and frequently break over shortly before harvest. At this time badly infested fields are characterized by heavy lodging. This results in additional labor to the farmer in harvesting, and much loss of wheat from shelling out.

The fourth class of injury is the direct effect of the feeding of the fly in sapping the vitality of the wheat plant, causing loss in weight of the grain. This takes place during the spring season while the larvae of the spring generation of the fly are feeding at the expense of the wheat plants. The amount of loss of this sort was demonstrated by a series of experiments which aimed to exclude all other factors affecting the plant. Samples of wheat plants were secured at harvest time from certain fields and the fly-infested tillers were separated from the fly-free tillers and kept in lots according to the number of Hessian fly puparia lodged in the tillers. Only those tillers which produced grain were used. The heads from each lot were carefully thrashed and weighed and the weight per head calculated. Table I summarizes six such experiments conducted on different farms and clearly demonstrates that the weight of the head decreases in proportion to the number of individual Hessian fly larvae that have fed on the tiller. It is interesting to observe that the difference in weight of the heads from the non-infested culms and those infested with one puparium is considerably greater than the difference in weight between any of the consecutive lots which are infested.

In Table II may be seen a comparison of the weights of wheat heads from fly-free tillers with those from fly-infested tillers. The weight of the grain from all the infested tillers of each sample was totalled, the

TABLE II.—THE WEIGHT OF GRAIN OF WHEAT HEADS FROM FLY-FREE CULMS COMPARED TO THE WEIGHT OF GRAIN FROM HEADS OF INFESTED CULMS[1]

Locality	Year	Number of heads		Weight per Head		Loss in Weight
		Non-infested	Infested	Non-infested	Infested	
Mt. Holly Springs, Pa.	1918	130	195	.02607	.02290	.00317
do	1919	100	130	.01601	.01115	.00486
do	1920	23	142	.02469	.01761	.00708
New Windsor, Md.	1921	190	80	.02732	.01832	.00900
Lewisburg, Pa.	1923	490	300	.02653	.02136	.00517
Bloomsburg, Pa., Farm No. 1	1924	126	377	.02314	.01863	.00451
do Farm No. 2	1924	92	425	.02392	.01632	.00760
do Farm No. 3	1924	245	161	.01715	.01300	.00415
Average				.02310	.01741	.00570
Total		1396	1810			

[1]In the farms from Bloomsburg, Pa., it will be observed that the weights per head from Farm No. 3 are much less than those found in Farms Nos. 1 and 2. This is explained by the fact that the wheat from Farm No. 3 was impoverished owing to poor soil and cultivation.

average weight per head calculated for each sample, and the difference in weight between the average infested head and the average non-infested head thus obtained. Samples of this character were taken from eight fields from four widely separated localities on different years as shown in the table, and the results from all the samples totalled and used as a basis for ascertaining the average loss in weight per head to be expected from the spring infestation of the Hessian fly. This figure came to .00570 ounces per head for each infested tiller, or approximately 0.09 bushels per acre for a 1% infestation.

Damage is also caused by lodging and prevention of heading, and in some instances loss will be sustained by the effects of the fly on the wheat during the fall season. It should, therefore, be held in mind that this estimate of damage represents only the type of injury due to the loss of weight in the grain and will come to somewhat less than the entire amount of damage to be expected from the fly.

PRESIDENT A. F. BURGESS: The next paper is by A. A. Granovsky.

THE ORGANIZED CO-OPERATIVE CAMPAIGN AGAINST GRASSHOPPERS IN WISCONSIN[1]

By A. A. GRANOVSKY, *University of Wisconsin*

ABSTRACT

The purpose of this paper is to record the successful methods used in the co-operative control of grasshoppers on a large scale. A total of over two hundred and fifty tons of mixed bait was spread on about 26,000 acres of land in the four co-operative townships by volunteer labor under supervision of the group of district leaders.

Sawdust was used as a base of the bait with no bran or middlings, and all "attractants" were abandoned except salt and molasses. The value of molasses is doubtful. The sodium arsenite as a killing agent is superior to white arsenic, being cheaper, perfectly soluble, quick in its action and much easier to mix uniformly with other materials in the bait. The organized co-operative campaign resulted in the year's crops being saved in spite of very heavy grasshopper infestation.

There are several species of grasshoppers that are more or less common throughout the different parts of the state of Wisconsin. The economic importance of any species depends largely on its number in a given area. The clear-winged locust, *Camnula pellucida* (Scudder) is believed to be the most numerous and most injurious of any species of grasshoppers, especially in the northern parts of the state. The aim of this paper is to

[1]Contribution from the Department of Economic Entomology, Wisconsin Agricultural Experiment Station.

give a brief summary of the co-operative control of this pest in four townships of Door County, Wisconsin.

Door County is situated in the northeastern part of the state, forming part of the peninsula which separates the waters of Green Bay from Lake Michigan proper. The peninsula is 18 miles wide at the base and gradually tapers to a width of about 4 miles. Its shores are very irregular, being indented by numerous bays and harbors. Ever since Door county was settled and changed from a forest to farming land, according to old settlers, it has been seriously infested with grasshoppers. Year after year many farmers harvested only a partial crop and some suffered a complete loss. From time to time there have been recurrent outbreaks, usually lasting only one or two years, during which the hoppers have taken everything, destroying the grain fields to the last straw and even killing the young fruit trees. For the past seven years, however, they became permanent pests in the northern half of the county and have been causing heavy losses, running into hundreds of thousands of dollars annually.

Many progressive farmers in Door county fought a bitter, single-handed battle with the hoppers. Individual growers, by devoting a great deal of attention, time and expense, were able to save part of their crops. In the northern part of the peninsula there are thousands of acres of waste land, unplowed clearings and slashings. Some of this land has not been cleared of the brush and stumps since the settlement of the country, and some of it is so rough and rocky that it is unfit for cultivation and is laying as a waste land or has been left undisturbed for pastures. These areas are particularly adapted for the breeding of grasshoppers, especially *Camnula pellucida* (Scud.).

In the summer of 1923 many pathetic appeals were made by the growers for help, complaining of the hopper invasion. As it was late in the season, nothing could be done with the exception of a few demonstrations, to materially remedy the existing conditions. It was evident that an organized action of all farmers in the infested areas was imperative. Such action was suggested to several chairmen of infested townships with the purpose of organizing a crusade to poison all waste lands and breeding places with arsenical bait. At a summer meeting of town chairmen it was decided to start an organized campaign against grasshoppers and a permanent organization—"Grasshopper Campaign Committee"—was formed for the period of the campaign.

In the mean time a careful and detailed study of the grasshopper situation was made along the following lines:

1.—The study of the life history and habits of the species in greatest abundance, with special reference to the breeding habits and breeding grounds.
2.—Development and tests of suitable cheap arsenical bait to be used in the campaign the following years.
3.—Formulation of plans for the campaign on which to base the work of the grasshopper control.
4.—Development of proper organization in each respective township for the successful campaign.
5.—Educational campaign among the growers in infested regions thru the rural schools and literature.

The study of breeding grounds revealed that *Camnula peilucida* (Scud.) is widely distributed all over the soil belonging to a group of loams, especially that of Miami loam and Miami fine sandy loam. The Miami loam is the most extensive and important type of soil in Door county and is the predominating soil throughout the infested region. The heaviest breeding grounds, however, have been invariably located on the Miami fine sandy loam. The surface of this soil consists of a friable, brown to grayish-brown fine sandy loam, from 8 to 14 inches deep. The subsoil is usually composed of a uniform yellow light-brown fine sandy loam and extends to the bed lime rock. The depth to bed rock varies considerably, although it is usually less than 3 feet. In places it extends as deep as 7 feet. In some areas gravel occurs on the surface and in the soil, rocks and bowlders are found upon the surface in considerable numbers and in places rock outcrops are quite common. The surface varies from undulating to quite rolling, often forming long ridges. On account if its surface relief and the light sandy texture, the drainage is excellent and affords splendid places for oviposition.

It has been observed that the clear-winged grasshopper migrates to this type of soil for its breeding. Its breeding grounds are usually found in dry permanent pastures, meadows, edges of woodlots, open and unbroken slashings, as well as along the road-sides. As a rule oviposition

TABLE I. SHOWING THE DEGREE OF INFESTATION BY OVIPOSITION

Type of breeding ground	No. of egg pods per sq. foot	Approximate No. of eggs in one pod	Degree of infestation	
			Per sq. foot	Per acre
Dry native pasture.....	71	20	1420	61,855,200
Along the road-side.....	59	20	1180	51,400,800
Stumpy slashing.....	67	20	1340	58,370,400
Rocky pasture.....	53	20	1060	46,173,600
Along the fence line.....	39	20	780	33,976,800
Along the edge of woodlot	32	20	640	27,878,400

takes place in a closely stripped grassy sod, and eggs are placed among the roots of Kentucky blue grass, *Poa pratensis*, and wheat grass, *Agropyron* sp.

In the fall of 1923 several types of breeding grounds were examined for eggs, the results of this study may be summarized in the preceding table.

This table shows an almost incredible number of eggs found in the soil of various types of breeding grounds. Next spring, however, proved the alarming situation, when in places young hoppers literally covered their hatching grounds.

The reasons why the northern part of Door County is so heavily infested with grasshoppers may be found in the following conditions:

1.—Only about 60 per cent of land is under cultivation while the remaining land is in woodlots, slashings, or is used for pastures. Some of it is so rocky that it is unfit for cultivation.

2.—Climatic conditions, on account of the moderating effect of the large bodies of water of Green Bay and Lake Michigan, are favorable for breeding the pest.

3.—As a rule, there is a late and warm fall, giving a longer period for the oviposition.

4.—During the winter the ground is well covered with a thick blanket of snow, preventing the ground from sudden changes in temperature.

5.—Late and gradual spring without alternate freezing and thawing is favorable for hatching of eggs.

These factors are extremely favorable for breeding of hoppers and overwintering of eggs in the ground. They are able to pass through the somewhat rigorous Wisconsin winters unharmed.

In the latter part of the summer of 1923 various formulae for arsenical baits were extensively tested with reference to the effectiveness of the bait, keeping in mind the availability and cheapness of material used. These tests were made in order to develop a formula well adapted for the campaign purposes under local conditions. The requirements of such a formula may be briefly summarized as follows:

1.—It should be inexpensive to be practical in application over a large acreage.
2.—Materials must be readily available on the market.
3.—The killing agent must be of such nature as to mix easily and uniformly thruout the base of the bait.
4.—All ingredients of the bait should be of such constituency as to mix thoroughly and quickly in large quantities in the least possible time.
5.—Bait should be comparatively safe to use and handle in the field.
6.—It should be attractive to grasshoppers.
7.—It should be effective in killing the pest.

After numerous tests on a small scale experimentally, several of the most promising formulae were tested under field conditions on a larger acreage. These formulae contained different amounts of various ingredients with reference to the base of the bait, killing agent, and attractants.

The following formulae proved to be superior to many others:

FORMULA I. U. S. STANDARD FORMULA

Bran	100 lbs.	
White arsenic	5 lbs.	
Amyl acetate, technical No. 1	3 ounces	Rate per acre 10 lbs.
Molasses	2 gallons	Cost per acre 35c
Water	12 gallons	

This formula is generally recommended and is extensively used throughout the United States under various conditions, with satisfying results. It gave good results in the above mentioned tests, but is quite expensive on account of bran being used as the base of the bait. Its cost is almost prohibitive when an extensive area is under consideration. The white arsenic is difficult to mix uniformly throughout the mash, especially in large amounts, for the powder may stick in larger quantities in one place and not enough in another. There is also a greater danger of poisoning cattle in the field, as the animals are readily attracted by the bran. On account of its glutinous properties, bran is somewhat difficult to evenly distribute over the field.

FORMULA II. BRAN AND SAWDUST

Bran	50 lbs.	
Sawdust	50 lbs.	
White arsenic	5 lbs.	Rate per acre 10 lbs.
Amyl acetate, technical No. 1	3 ounces	Cost per acre 26c
Molasses	2 gallons	
Water	12 gallons	

This formula has been used in several localities of the United States and Canada quite successfully. In trials under Wisconsin conditions it gave good results, but it has most of the disadvantages of the Standard U. S. formula although it is cheaper and yet not cheap enough to use on a large acreage. It has one decided advantage by having sawdust equal to 50 per cent of its bulk. The sawdust seemed to improve the spreading quality of the bait considerably.

FORMULA III. WISCONSIN FORMULA

Hardwood sawdust	85 lbs.	
Middlings	15 lbs.	
White arsenic	5 lbs.	Rate per acre 10 lbs.
Amyl acetate	12 ounces	Cost per acre 17c
Salt	4 lbs.	
Water	12 gallons	

This formula had been developed by Mr. C. L. Fluke some years ago. It has been used for several years in Wisconsin with good results. It proved to be just as effective as the U. S. Standard formula and is considerably cheaper and consequently is more practical in its application. Its spreading quality is good and there is less danger of poisoning stock, but it is just as hard if not harder to mix than the U. S. Standard formula, for there are two items, namely, white arsenic and middlings, that are difficult to mix uniformly to make the bait successful. This is especially true in mixing the bait in large quantities.

FORMULA IV. WISCONSIN CAMPAIGN FORMULA

Sawdust	100 lbs.	
Sodium arsenite	1 quart	
Salt	5 lbs.	Rate per acre 10 lbs.
Black strap molasses	1 gallon	Cost per acre 8c
Water	10 gallons	

This formula was specially developed for the Door County campaign. It proved to be equal to the above mentioned baits in killing effect. It is half as cheap as the Wisconsin formula, and more than four times cheaper than the U. S. Standard formula. Amyl acetate as an "attractant" has been abandoned. Straight sawdust was used without the middlings or bran. Liquid poison—sodium arsenite containing 50 per cent As_2O_3 ("Ussco Weed Killer"), was used instead of solid powder—white arsenic. The sodium arsenite is perfectly soluble in cold water in less than a few minutes. By the virtue of its solubility it is very easily and uniformly mixed with the base of the bait, and every particle of the sawdust that is moistened in the mixing process—at the same time is uniformly poisoned. Liquid poison is much easier to mix with the other ingredients of the bait in a very short time in large quantities, which is an important factor to consider in mixing several hundred tons of bait. Black strap molasses was used to counteract the fresh odor of the sawdust and to keep the bait moist longer. Its value, however, is doubtful. Salt is of decided importance in the bait at least under Wisconsin conditions. It is evidently a factor of taste and probably of smell in the species under consideration.

Comparing the efficiency of these formulae in the field tests, it was found that Formula IV has all of the advantages of the other formulas and besides has several additional valuable advantages over the others. This formula has been selected for the campaign and on account if its being entirely new in its structure and application, it is called Wisconsin Campaign Formula.

The essential features of the plan of the campaign in brief included the following points:

1.—Grasshopper control should be carried by townships rather than by individual farmers.
2.—Supervision of entire project by an entomologist connected with the Peninsular Experiment Station in co-operation with the County agricultural agent.
3.—Advance educational campaign through the schools, papers, meetings, posters, correspondence, etc. so that all growers in infested areas would be thoroughly informed as to the plans.
4.—Townships purchase all necessary material through the agency of the Experiment Station.
5.—Poisoning of all waste and cut-over land, pastures, fence lines, roads and other infested areas, before migration of the hoppers begins in the spring, followed by a second poisoning where necessary.
6.—Mixing and spreading of poisoned bait by crews of volunteer labor under supervision of paid district or group leaders.
7.—Every possible effort to be made to secure cordial co-operation of everyone, including non-resident land owners.
8.—Use of compulsion and of the state pest control law to be invoked as and only as, a last resort where other methods failed.

During the winter, according to plans, an educational campaign was carried on through papers, posters and small circulars regarding the forthcoming campaign. With the consent of the Superintendent of the Door County schools, all the teachers of the rural schools were urged to make a study of grasshoppers, their life history, and habits, as well as methods of control. It was one of the best means of distributing a great deal of valuable information regarding the pest and reaching the farmers through their children.

All townships co-operating against grasshoppers were divided into districts of from four to six square miles, and reliable men living in these districts were appointed by the town chairmen to be held responsible for their particular areas. These men were called "district leaders."

In the winter, district maps were prepared showing the accurate position of each farm with its acreage and owner's name. These maps were sent to each district leader who indicated as accurately as possible the location and acreage of the breeding grounds on each farm of his district. From these maps it was estimated that nearly 26,000 acres would have to be covered with the poisoned bait during the campaign to insure the safety of the farmers' crops.

In order to eliminate the hand mixing of the poisoned bait, which is a dangerous, laborious, slow and expensive process, a machine was devised for the purpose. It proved to be successful in mixing the poison uniformly in the bait with a considerable saving of time.

At the annual town election meetings, the plan of campaign was explained to people and a number of details discussed. Four townships and two villages voted to carry the campaign and made appropriations to cover the work. The State Peninsular Park also joined the campaign to help the neighboring farmers by destroying the pest on breeding grounds of Park property.

Additional meetings of town chairmen, boards and district leaders were held in the spring of the year to complete the details of the plans and to acquaint each of the district leaders with the part he was to play in the campaign. They were instructed that their duty was to see that every acre of grasshopper land in their respective districts be poisoned before the beginning of migration of the pest to the grain fields.

The committee, consisting of the president, secretary, and treasurer was empowered by the meeting of town boards to act as an executive committee in matters demanding immediate attention, and for the payment of bills incurred in the campaign. The entire campaign organization thus resembled a pyramid in its form, based on the individual farmer, on whose integrity the success of the campaign largely depended. The farmers in each district were under the direct charge of their district leader. The leaders, in turn, were responsible to their town boards and finally to their town chairmen. The town chairmen, the village representatives, the superintendent of the State Park, the county agent and the station entomologist composed the campaign committee proper. The work finally headed up in the executive committee, the county agent and the station entomologist.

The actual mixing of the poisoned bait began June 26, 1924 simultaneously in the two townships and the State Peninsular Park. The spreading of the bait followed the next day. At the end of one week, the work began in two other townships and villages. Each township had its own organization with its own mixing crews centrally located. The mixing crews were made up of men, one from each district of each township, and in charge of one person carefully instructed as to the handling and mixing of the poison. The mixers were placed near the old sawdust piles in close proximity to water. The sawdust mixed with chips of bark was sifted to prevent animals from getting hold of a large piece containing enough poison to cause death.

Each mixing crew was organized in such a manner that each man was assigned to his definite job, and all of the steps in the process of mixing the bait were performed by different men at the same time. This added much to the efficiency of the work, and each of the mixing

crews in four townships mixed about 400 pounds of wet bait in every six minutes. It took a fraction less than 2 minutes to load the mixer, 2 minutes to mix the bait by swinging and rotary motions, and 2 minutes to unload the contents of the mixer.

Hundreds of sacks were filled and refilled with the poisoned bait every day. The sacked bait was regularly delivered by trucks to different spreading crews in each township simultaneously. Each district with its spreading crews had its own truck for that purpose.

In order to save time and increase the efficiency of the spreading work, each crew was also provided with a horse and wagon or buggy. Bait was unloaded from the trucks on horse vehicles which were following the spreading crews in the fields, slashings and rocky pastures and in that way constantly kept the supply of the bait within easy reach.

The spreading of the bait was carried on by the district crews each in charge of a district leader. The men in the crew were lined in a scrimmage about 20 or 30 feet apart and crossed the given breeding ground, sowing from 10 to 20 pounds of wet bait, depending on the degree of infestation.

Poisoned bait was spread in many pastures where close grazing sheep as well as cattle, were confined, without a single casualty among live stock traceable to the distributed poison. When bait is properly scattered, there is no danger of poisoning either stock or poultry. Sawdust is not an attractive food for the animals, while the use of bran probably would have resulted in cattle mortality.

In two weeks of the campaign over 250 tons of the bait were mixed and distributed on about 26,000 acres of land. It took over 125 tons of sawdust, 600 gallons of sodium arsenite, 45 barrels or 2,630 gallons of black strap molasses, and over 12,500 pounds or 45 barrels of salt to save over $200,000.00 worth of crops from grasshopper destruction. Many individual farmers stated that for the first time in forty years they have had a full crop of grain, while in previous years they suffered losses from one hundred to seven hundred dollars each annually.

The original plan called for a second application of bait over the entire area. Only in one township there was a considerable secondary poisoning done, because of the heavy and continued local rains during the campaign, which lessened the effects of the first application. In other towns very little secondary poisoning was necessary on account of excellent results obtained from the first application.

The summary of the campaign may be given in the following table:

TABLE II. THE SUMMARY OF THE CAMPAIGN

Community	Treated area in acres	Cost of material	Cost of mixer and drayage	Total amt. of money used	Amount of money appropriated	Money left + Overdrawn —
Liberty Grove	8550	$549	$124	$673	$600	—$73
Gibraltar	5250	318	63	381	1000	+619
Egg Harbor	5700	446	88	534	600	+ 66
Baileys Harbor	4500	355	51	406	600	+194
Jacksonport	460	32	5	37	——	——
Sister Bay	580	40	——	40	40	——
Ephriam	350	30	——	30	30	——
State Park	350	30	——	30	30	——
Total	25,740	1800	331	2131	2900	——

This table shows that the total expenditures made were only $2,131.00 to cover 25,740 acres of heavily infested land. The cost per acre is only $0.08.27, not including the labor, which was volunteer, except that of district leaders, which was a very insignificant amount as compared with savings.

In order to determine the extent of grasshopper infestation and the killing effect of the campaign bait formula, several field tests were made at the time of the campaign.

The field tests were carried as follows: Three plots of typical breeding grounds at different localities were selected. The degree of infestation before poisoning was determined by the two foot square wire cage with open bottom and upper side with door on hinges. Long ends of rope were used to avoid disturbing the hoppers while walking. This cage was carried by two men about 25–30 feet apart. When the cage was quickly lowered to the ground it entrapped the hoppers on the given area. The lid of the cage was then opened and the entrapped hoppers were counted with mechanical counters to determine the infestation per square foot. The infestation was found to vary from 17 to more than 200 hoppers to a square foot. Several slashings were literally covered with swarming nymphs and their number defied any attempt at counting.

When the infestation was determined, the poisoned bait of the campaign strength and amounts was applied. Three days later the degree of infestation by the cage method was determined again. It was found that the efficiency of the bait proved to be from 86 to 93 per cent.

These tests were conducted from July 1 to July 6, 1924. The campaign was conducted from June 27 to July 18, 1924.

Further proof of the effectiveness of the campaign bait was obtained in the experiments conducted in co-operation with the U. S. Bureau of Entomology, results of which will be published later.

Although at the beginning of the work there were many who doubted the success of the campaign, this obstacle was removed by the educational campaign and personal contact with the growers. In the very first days indifference was removed and the campaign received wholehearted support. Perhaps the most outstanding point in the entire campaign has been the remarkable degree of co-operation shown by every person connected with the work, from the township officers to the individual farmers. Not once was it necessary to resort to the legal means available in order to secure the necessary help.

The campaign not only saved the crops, but it also taught the farmers a lesson in co-operation. The educational value of this work is self-evident.

In order to reduce the hoppers to a negligible number, it will require at least one more year of organized effort as contemplated in the original plan.

PRESIDENT A. F. BURGESS: The next is a paper by George I. Reeves.

THE ARSENICAL POISONING OF LIVESTOCK

By GEO. I. REEVES, *Associate Entomologist, Bureau of Entomology, U. S. Department of Agriculture*

ABSTRACT

Recommendations for the spraying of alfalfa to control the alfalfa weevil, *Phytonomus murinus* Fabr., have been guided largely by Dr. H. C. Gardiner's work on the arsenical poisoning of domestic animals, which was recorded in the transcript of the Riverside Dairy Case in the United States District Court of Utah, but which has not heretofore been readily accessible to entomologists and the public, to both of whom it is of the highest importance. Dr. Gardiner, in an exhaustive series of feeding experiments, clinical observations and autopsies, determined the physiological effect of various doses of arsenic, continued for various periods of time, upon farm animals. The dangerous dose was shown to be far greater than the amount which is contained in a feed of sprayed hay.

Because of the growing use of arsenical salts for controlling insects, entomologists are often asked difficult questions about the danger of poisoning livestock, especially where the poison is applied directly to forage as in spraying for the alfalfa weevil. Although thousands of tons of sprayed alfalfa hay are fed to horses, cattle and sheep every year without doing any harm, yet there are reports of poisoning resulting

from spraying operations, causing anxiety which is hard to allay because information on the subject is not readily available.

Dr. H. C. Gardiner, of Anaconda, Mont., made a complete digest of the literature available in English, French, German, and Italian, and found that it dealt largely with accidental poisonings in which no control had been exerted, that there was no record of any careful or systematic investigation of the tolerance of the various domestic animals for arsenic, and that the little experimental work had been done in a small way and upon small animals.

For these reasons, Dr. Gardiner's evidence as recorded in the Riverside Dairy Case before the U. S. District Court of Utah should be more widely known. It deals with the tolerance of farm animals for arsenic and describes the symptoms of arsenical poisoning and the lesions produced by it, and is based upon an extended series of feeding experiments, accompanied by clinical observations and followed by autopsies. The following digest has been prepared from the 65 pages of transcript which it occupies in the court records, and has been approved by Dr. Gardiner:

The fatal dose of arsenic for farm animals, the amount which is merely harmful, and the medicinal dose were determined in a series of experiments continuing for 18 months, in the course of which Dr. Gardiner administered arsenic in the forms of arsenic trioxide, Fowler's solution and flue dust containing 20 per cent arsenic, to large numbers of horses, cattle and sheep. He proved that horses and cattle can take, without any external evidence of injury or any alteration discernible upon the most careful postmortem examination, from 20 to 30 grains of arsenic daily, month in and month out. This corroborates the experience of the Tyrol, where horses which have hill work to do are fed as high as 30 grains of arsenic a day to increase their endurance and enable them more advantageously to do their work, as also the experience of this and other countries where arsenic is fed to horses to make the coat glossy and enable the animal to take on fat more readily. Sheep, being comparatively small animals, are more easily poisoned, requiring only from 4 to 8 grains daily. The fatal dose for horses and cows is 300 grains.

Arsenical poisoning is produced only by a large dose of arsenic which is absorbed from the intestines into the circulation and attacks the liver, which, in addition to its connection with the process of digestion, has the function of arresting and rendering harmless not only the ordinary poisonous products of decomposition which occur in the intestines and are transported to the liver, and which but for the liver would be fatal,

but also mineral poisons such as arsenic. In acute arsenical poisoning there occurs an over-intoxication resulting in an actual destruction and conversion into microscopic fat of the cells of liver tissue proper within their framework of connective tissue, and the liver loses its ability to eliminate poisons. In case of a dose sufficient to cause poisoning there is always a considerable amount of arsenic found in the liver; that is, from 10 to 15 times as much as in the other tissues of the body.

In cases of acute arsenical poisoning the strongest and most general symptom is a profound depression, or coma, as if the animal had been given morphine. There is also an elevation of the pulse, uneasiness and sometimes slight evidences of abdominal pain, not, however, resembling colic. The earliest evidence is in the animal's facial expression, especially in horses.

The lesion most generally seen in sheep and cattle is an inflamation of the stomach and the abdominal wall near which it lies just back of the ensiform cartilage at the base of the sternum, producing adhesions and serous infiltration with necrosis, usually readily detected by external examination when well advanced.

Arsenic produces no lesion of the bones, such as rickets; its effect upon the nutrition of the body, when given in medicinal doses, is of an opposite character. If an animal is anemic and the nutrition is faulty, arsenic is administered and seems to have the power of taking the place of iron in the red blood corpuscles.

Arsenic does not affect the lungs or tracheae except as a tonic; and there is no shortness of breath except as a consequence of pain and shock to the nervous system in acute cases, or of stiffness in front of the ensiform cartilage in chronic poisoning.

The ulceration and inflammation of the fourth stomach in acute arsenical poisoning are entirely different from those arising in other disturbances of that organ and therefore most characteristic. The infiltration of the mucous and sub-mucous tissues is of a peculiar character, the usual reddening is absent and there is a peculiar charring of the membrane. Instead of the ordinary ulcer there is a raising of the tissues over the point, which would probably become an ulcer if the animal survived. There is a peculiar hemorrhage and yellow-mottle of the wall of the stomach and intestine, a magnified picture of which might be compared to a leopard's skin—little pinpoint hemorrhages resembling the tufts of blood vessels seen in the kidneys, surrounding areas which are not reddened or inflamed but blanched or yellowed.

In cases of chronic arsenical poisoning, the symptoms differing from

the ordinary appearances of unthrift and common digestive disorder, including loss of weight, are very few and slight. Where the poisoning has existed for any considerable period there is a marked thickening of the skin and a formation of layers of dead scurfy-looking material on its surface.

The existence of arsenical poisoning in domestic animals is determined, first, by the history of the case; second, by clinical symptoms such as those referred to above; and third, by the presence of acute nephritis indicated by blood and casts in the urine and the presence of unusual and considerable amounts of arsenic in the urine and the faeces.

The effects of long-continued chronic arsenical poisoning are permanent, and the animal does not completely recover. If the effect is only slight and comes short of chronic poisoning, a change of food and removal from the smelter smoke zone might be expected to cause an improvement, but where fundamental changes have taken place in the liver and kidneys the improvement would be slight.

Dr. Gardiner's work came to my attention very opportunely in 1914, when the spraying of forage was considered so hazardous[1] that permission to spray a field could usually be obtained only by purchasing the crop. No chemical analysis had been made of the alfalfa which was sprayed in 1913, because the poison was applied in April, when the plants were only a few inches tall. The experiment was designed to test a suggestion of my former assistant, Mr. H. S. Smith, as to poisoning the adults before they began ovipositing, and as no notes of previous attempts at spraying were available, it was intended simply to show the effect upon the insect of different arsenical poisons, the most promising of which might be used in later experiments. Zinc arsenite proved to be the most effective poison and the control obtained by its use was enough to warrant paying some attention in 1914 to the effect upon the feeding value of the hay. Samples from a field sprayed with 2½ pounds of zinc arsenite to the acre were analyzed by the Bureau of Chemistry and found to contain 9.86 parts per million, dry basis, or 2 grains in 30 pounds of hay. Samples from a field sprayed with 5

[1]Utah Exp. Sta. Bull. No. 110, 1910, p. 68. "Unfortunately, the saving of the crop by this means may also be the poisoning of it so that it could not be used for food."

Utah Ag. Coll. Circ. No. 10, 1913, p. 118. "The larvae are readily poisoned with arsenical compounds, but any insecticide sprayed on the plant that will kill the larvae will render the hay unfit for use."

Idaho Coll. Agr. Ext. Bull. No. 7, 1913, p. 17. "These include the use of arsenical sprays, (which renders the hay unfit for food)——."

Utah Agr. Coll. Exp. Sta. Circ. No. 31, 1918, p. 8. "To spray the crop when it is almost ready for cutting renders the hay unsafe for use."

pounds to the acre contained 4.38 parts per million, or 0.9 grain in 30 pounds. Duplicate samples from these fields, analyzed by Dr. Herman Harms, Utah State Chemist, contained only traces of arsenic. This second year's work, at the same time that it indicated the possibility of feeding sprayed hay, showed also the importance of determining the arsenic content, for it pointed definitely toward spraying to kill the larvae in June when the plants are large rather than the adults in April.

Upon the advice of Mr. Byron Hunter, of the Office of Farm Management, who made a survey of the alfalfa weevil situation and the various control methods, and with Dr. Gardiner's work as a guide, a series of experiments was begun which lasted four years and established spraying as the standard method of controlling the alfalfa weevil. In the course of resulting demonstrations by entomologists and county agents and of practical operations by farmers, many analyses of treated hay have been made.

In 1919, samples from standing alfalfa which had been sprayed by Prof. Claude Wakeland at Paonia, Colo.[2] with zinc arsenite at the rate of 2½ pounds to the acre were analyzed by Dr. W. P. Headden and found to contain from 6.5 to 19.5 parts per million of arsenic trioxide, and a sample from a field sprayed with 4 pounds of lead arsenate to the acre yielded 31.4 parts per million.

In 1920, three fields sprayed by Mr. Vere Martineau, County Agent of Salt Lake County, with 2½ pounds of calcium arsenate to the acre contained respectively, according to Mr. C. F. Stack, of the American Smelting and Refining Company, 34.8 parts per million, or 7.4 grains in 30 pounds, 11.2 parts per million, or 2.4 grains in 30 pounds, and 31 parts per million, or 6.6 grains in 30 pounds. These samples were taken from standing alfalfa, one week after it had been sprayed, while those previously mentioned as having been analyzed in 1914 were taken from winrowed hay, about two weeks after spraying; this difference helps to account for the greater arsenic content in the 1920 samples.

In 1921, samples taken from winrows of hay sprayed with 2½ pounds of calcium arsenate an acre yielded, according to the Bureau of Chemistry, 128 parts per million, or 26.88 grains to 30 pounds. Other samples of the same hay, taken nine months later from the stack where it was being fed, yielded, according to the Bureau of Chemistry, 69.8 parts per million, or 14.7 grains in 30 pounds; and according to Mr. Stack, 75 parts per million from the leaves and fine stems, 10 parts per million from the coarse stems, and 50 parts per million from the mixture as it

[2] 10th Ann. Rep. St. Ent. Colo., 1919, p. 32.

would be fed. The last is equivalent to 10.5 grains in 30 pounds of hay.

In that year the first attempt was made to control the alfalfa weevil by the application of arsenical dust, and since we did not at that time understand the rôle which is played by electricity in insecticidal dusting we used considerably larger quantities of poison than necessary, but, fortunately, although we did not know the importance of the electrical charge, we availed ourselves of Mr. F. A. Frazier's practical experience and included sulphur with the calcium arsenate in the dusting mixture and thereby insured the adherence of the poison to the foliage.

Samples which had been dusted with 8 pounds of calcium arsenate to the acre, contained, according to the Bureau of Chemistry, 138 parts per million, or 28.98 grains to 30 pounds; and samples dusted with 2 pounds to the acre contained 88 parts per million, or 24.64 grains in 30 pounds.

In 1922, samples which were dusted by Prof. Claude Wakeland, of the Idaho Experiment Station, with 2½ pounds of calcium arsenate to the acre, contained 39.6 parts of arsenic trioxide per million, or 8 grains in 30 pounds, those dusted with 3⅓ pounds contained 59.4 parts per million, or 12.47 grains in 30 pounds, and those dusted with 7⅛ pounds contained 108.24 parts per million, or 22.7 grains to 30 pounds. In comparing this Idaho dusting with that previously described, it should be remembered that it was done without the use of sulphur or other electrolyte, a circumstance which reduced the arsenic content, while the samples were taken from standing alfalfa instead of winrows, a method which would tend to increase it.

The samples described above are far from consistent as to their arsenic content, but they cover sufficiently varied conditions of application, sampling, and analysis, to make it clear that the arsenic content of sprayed and dusted hay comes within the limits of safety prescribed by Dr. Gardiner. Nevertheless there are occasional reports of livestock poisoning caused by arsenic in alfalfa hay. One such case occurred at Logan, Utah, in 1921. The county agent who investigated it found that the orchard had been sprayed with lead arsenate at the rate of 12.8 pounds an acre, and that the hay which had been cut under the trees was reported to have poisoned four horses. No authentic diagnosis reached my hands, but it seems likely that the poisoning took place.

There were reports of the poisoning of dairy cattle at Delta, Utah, in 1924, as a result of feeding sprayed hay, but no evidence of actual poisoning was obtainable, and analyses of sprayed hay from that district showed an arsenic content of only 0.4 part per million, or 0.084 grain in 30 pounds of hay.

Long experience of rumours of poisoning caused by sprayed hay has shown that they are usually as elusive as those of persons who live to the age of 120 or of German spies who put ground glass in Red Cross socks and fungus spores in American wheat fields; in each case it is easy to find neighbors, grandchildren, or second cousins of eye-witnesses, but difficult to get at the witnesses and impossible to find any real evidence. The reports of arsenical poisoning just described are unusually definite. Prof. Claude Wakeland has, however, recently had an opportunity to make first-hand observations, accompanied by actual clinical diagnosis and history, together with chemical analysis, of what must, in the absence of complete knowledge, have been recorded as an authentic case of poisoning due to the spraying of hay. Dairy cows were taken from a ration of old dry hay and fed new sprayed hay which had been rain-soaked. They sickened and the owner believed that they were poisoned by arsenic, but he continued in the interest of science to feed them the sprayed hay and they recovered. The analysis of the suspected hay yielded 43 parts per million of arsenic, equivalent to 9 grains in 30 pounds.

While an entomologist experimenting with or demonstrating the spraying of alfalfa is unlikely to see an actual case of poisoning, there is a possibility of it. County agents in Utah have found farmers innocently using white arsenic instead of calcium arsenate, and sodium arsenite is legitimately used for spraying roadside weeds. There is much greater danger that he will be called upon to distinguish a real case of colic, surfeiting or starvation, from arsenical poisoning, and in such a case Dr. Gardiner's excellent description will be useful.

MR. G. E. SANDERS: I would like to ask if Mr. Reeves has any data on the relative toxicity of arsenates and arsenites.

MR. G. I. REEVES: Do you mean those that are commonly used in industry?

MR. G. E. SANDERS: Particularly combining those with the same base, say, sodium.

MR. G. I. REEVES: We don't use sodium arsenite for spraying foliage.

MR. G. E. SANDERS: Of course, but I wanted to know if you had any data as to their poisoning value.

MR. G. I. REEVES: I think not, as concerns the toxicity itself. Of course, there is a very important difference in the action of zinc arsenite and calcium arsenite. Zinc arsenite is an electrolyte. It is a non-conductor of electricity and when used in dusting it adheres to the foliage

without any help while calcium arsenite is practically useless unless used with sulphur or silicate, some electrifiable substance, which will make it effective.

PRESIDENT A. F. BURGESS: The next paper is by M. C. Lane.

THE ECONOMIC WIREWORMS OF THE PACIFIC NORTHWEST (ELATERIDAE)

By M. C. LANE, *Assistant Entomologist, Cereal and Forage Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture*

ABSTRACT

This paper purposes to treat in a general way the damage caused by the three species of wireworms of principal economic importance in Washington, Oregon, and Idaho, namely, the inflated wireworm, *Ludius inflatus* Say, the dry-land wireworm, *Ludius noxius* Hyslop, and the wet-land wireworm, *Pheletes occidentalis* Candeze. The paper brings out interesting ecological data which show that each of these species inhabits a separate region under distinct environmental conditions, as regards rainfall and moisture content of the soil. A general life history is given for the dry-land wireworm, showing the total life cycle of this species to be four or more years. A brief summary is given of the damage caused by the wet-land wireworm under irrigated farming conditions together with some interesting facts about the habits of this species during recent years. The final purpose of the paper is to show that more comprehensive basic ecological studies of the many species of wireworms should be made, with much more time and care given to them than in the past. With a more thorough knowledge of the many ecological factors involved in the increase of wireworm infestations and damage, there should be found some satisfactory answer to the oft repeated question, "How can we get rid of wireworms?"

The principal wireworms of economic importance in the States of Washington, Oregon, and Idaho are to be found in the region between the Rocky and Cascade Mountains, usually known as the Inter-mountain Region. This section, which comprises most of the arable lands of eastern Washington and Oregon, together with southern Idaho, drained by the Columbia and Snake Rivers, can be divided into three parts on the basis of rainfall, with attendant differences in the flora and wireworm species.

The first division, designated as the Arid Transition area (timbered)[1] bordering on the mountains, has a rainfall of from 18 to 20 inches or more annually, and is adaptable to diversified farming. This area contains some of the most valuable land of the west, but only during the last few years has anything but wheat been produced in this region, under dry farming methods.

[1]According to C. V. Piper, Flora of State of Washington, Contributions to the U. S. National Herbarium, Vol. 11, 1906.

The inflated wireworm (*Ludius inflatus* Say), which is the principal injurious species in this region, is widespread throughout the three States wherever the rainfall exceeds 15 inches annually. Its economic importance arises from its ability seriously to cut down the stand of wheat plants during the early spring months of March, April and May. Its damage is evident especially in those fields in which the stand has been reduced through winter injury. Recent farming methods involving summer fallowing this land every other year, keeping the land entirely free from all plant growth for one season, not only preserve the moisture and nitrates, but also help to eliminate a great many of the wireworms. As this is generally a region producing good stands of winter grain in the spring, however, reports of damage by this species are only periodic. While the life history of this particular species has not been thoroughly worked out, it will be found to be substantially the same as that of the dry-land wireworm (*Ludius noxius* Hyslop), as they are closely related, although there is a rather sharp line of demarcation between the habitats of the two.

The second division, which is designated as the Arid Transition (timberless)[1] has a rainfall of from 10 to 18 inches annually and comprises an extensive area of sage-brush, rolling prairies, now largely broken up for the production of both winter and spring wheat, under strict summer-fallow methods. Since most of this area is too high and extensive ever to be irrigated, wheat will be the chief crop possible for many years to come.

Under the conditions met with in this division, the main species of economic importance is the dry-land wireworm (*Ludius noxius* Hyslop)[2]. This wireworm, which is native in the sage-brush and bunch-grass lands of the Great Basin and is never found in regions having more than 15 inches of rainfall annually, has readily changed its feeding habits to include wheat and other grains, and multiplies abundantly under the new conditions. It does considerable damage every year, but, as with the inflated wireworm, its greatest damage is noticed in the spring by the farmer only in years of severe winter injury to the grain. Many years of constant wheat production have reduced the nitrates in the soil, and this deficiency, combined with low annual rainfall, has forced the farmers to a very strict summer-fallow system. It has been found by the Agricultural Experiment Stations of these States that early spring plowing, followed by frequent cultivation to keep all weed growth elim-

[2]According to Dr. E. C. Van Dyke of the University of California, this species is probably only a northern race of the Great Basin wireworm (*Ludius pruininus* Horn) which is slightly smaller in its northern range.

inated, is the best farm practice to follow in this region. The precipitation in this area occurs in the winter months, mostly in the form of snow. The months of June, July, August and September usually are very dry. The dry-land wireworms have adjusted themselves to this condition so that they feed only during March, April and May, or as long as the temperature remains cool and the moisture is found near the surface. On the advent of hot weather the soil dries out below the crowns of the plants, the activity of the wireworms ceases, and they descend deeper into the soil and suspend feeding until the following spring.

This species, which usually makes a vertical cell in the hard packed soil below the plow line at an average depth of 7 inches, pupates in late July and early August. The beetle, which remains in this cell until the following spring, can withstand freezing temperatures without injury. Beetles broken out of the frozen soil in March and exposed to the warm sunlight for a few minutes become quite active. The beetles normally emerge from the soil when the temperature at a depth of 8 inches reaches approximately 55 degrees F. For several seasons in central Washington this has occurred during the first two weeks in May. Male adults fly freely on sunny days at temperatures above 65 degrees F., but their total period of life usually does not exceed 20 days. The males have been observed at rest on sagebrush, but never have been observed to feed during their short period of existence; in fact, they performed all their functions under laboratory conditions without taking any food or moisture whatever. Several seasons of observations have never disclosed a female adult in flight and rarely was the female ever found abroad in the fields. She apparently remains quietly under clods, until sought by the male, and probably migrates only by crawling short distances. After mating the female burrows down in the soil probably near where she emerges and deposits her eggs in the cool, damp soil at a depth of at least 6 inches. There is no evidence that the female ever emerges more than once from the soil.

Under laboratory conditions in the underground cellar, where the temperature was maintained at approximately the same degree as prevailed at a depth of 8 inches in the soil out of doors, the pre-egg stage, or period from copulation to deposition of the first eggs, was found to be about 23 days, varying for different individuals. Under the same conditions, the egg stage was of approximately 28 days duration, although it was very difficult to determine this accurately, since it was not desirable to disturb the adults every day for fear of producing abnormal conditions and thus interfering with obtaining the total egg-laying period.

Apparently, however, the eggs are all laid singly in one place, and within the period of a few days. The eggs are pearly white, nearly round, and average in measurement 0.6 by 0.4 of a millimeter. Under laboratory conditions females readily oviposited and this season (1924) 29 females deposited an average of 382 eggs each. Of these females, 22 oviposited over 350 eggs, 14 over 400, 5 over 450, and 2 over 500. The maximum was 535 and the minimum 201 eggs. The eggs are easily desiccated and will not withstand exposure to superterranean air conditions. They should be handled under such humid conditions as would be normal at some depth in the soil.

The larvae of the dry-land wireworm, which hatch during the latter part of June, are pure white, with dark mandibles, and are barely a millimeter and a half in length at emergence. After feeding on sprouting grain for a year, these larvae attain a length of only about 5 or 6 mm., showing very slow growth, even under ideal conditions. The wireworms become slightly darker colored with each molt, the average number of molts being two, though some individuals molt three or four times. Molting does not seem to take place during the active feeding season, the first molts appearing in laboratory material and also in the field not earlier than June, others appearing in August and sometimes a third molt in September. Larvae starved throughout the season under laboratory conditions moulted the same number of times as those fed normally, and after several years without food some of these starved larvae became adults.

This species has not been reared through the complete cycle from egg to adult as yet, but the whole period of its life evidently is not less than four years from egg to final adult emergence during spring. It is apparent that while this might be the normal life cycle, certain individuals under abnormal food and soil conditions might easily undergo a longer period, and in fact several individuals have now been carried along for over six years, with no apparent change in development.

It can be seen that the vital period in the life of this species is during its first season after hatching. It must have growing, succulent food during July and August in order to survive under the very dry conditions met with in its native habitat at this season. A weedy, summer-fallowed field with good moisture conditions and plenty of succulent rootlets furnishes ideal feeding conditions. In fact nearly every bad case of wireworm infestation has been traced back one or two years to a time when the summer-fallow was allowed to become very weedy. The presence of one large tumbleweed in a field with the addition of a

female beetle to deposit over 400 eggs, readily explains why this particular spot in the field may have serious damage from wireworms after a year or two.

The third division, called the Upper Sonoran Zone, has a normal rainfall of less than 10 inches annually, and comprises an extensive area of land in sage-brush, none of which will support a farm population without the addition of irrigation waters. A great part of this arid, desert section has already been watered and the resultant crops grown on these irrigation projects, such as the Yakima Valley, are abundant proof that fertility is not lacking.

In this area still another species occurs that is considerably different from the preceding ones, namely the wet-land wireworm (*Pheletes occidentalis* Candeze. This wireworm is native throughout the three States, wherever there are swampy places near streams and lakes, and it is also known from the humid coastal region west of the Cascade Mountains. This species never was reported as doing much damage until the advent of irrigation and then not until the land had been thoroughly soaked and cultivated for several years. It readily migrates from its native habitat to the irrigated fields, and the intensive cultivation of irrigated lands seems to facilitate its increase rather than act as a hindrance, as is commonly supposed. The female of this species flies freely and her egg-laying ability is only slightly inferior to that of the dry-land wireworm. This wet-land wireworm feeds on a variety of crops, from potatoes, corn, and root crops, to grains, alfalfa, and nursery stock. In Washington State alone it is conservatively estimated that this wireworm is destroying marketable crops to the extent of over one million dollars annually. In the Yakima Valley it was estimated by the District Horticulturist that the damage to the potato crop of 1922 was approximately $300,000, all on account of the feeding punctures and tunneling of the tubers done by this species during July and August. At least 500 carloads of potatoes were reduced to culls and 600 more were reduced one grade, out of a total crop of 6,000 carloads harvested that season.

This wireworm also plays havoc in nursery stock, of which there is a considerable acreage under irrigation. It destroys the apple, pear, peach and other seeds during early spring before they sprout, cuts off the tender seedlings after sprouting, eats out the lower buds where they become covered with soil, and finally by girdling kills the one-and two-year-old grafted stock. Damage from this species is being reported and observed on every irrigation project of the Pacific Northwest and there seems to be no crop that is not attacked to a greater or less extent.

In conclusion, it is evident that more basic ecological studies of the many species of wireworms will have to be made, involving much more time and care, and extending over much longer periods than in the past. When these are completed and a more thorough knowledge of the many ecological factors involved in the increase of wireworm infestations and damage is had, there should be found some satisfactory answer to the oft repeated question, "How can we get rid of wireworms?".

PRESIDENT A. F. BURGESS: As the next three papers all relate to the European corn borer, discussion will follow the last paper. The first paper of this series is by L. S. McLaine and H. G. Crawford.

THE STATUS OF THE EUROPEAN CORN BORER IN ONTARIO (1924)

By L. S. MCLAINE and H. G. CRAWFORD, *Entomological Branch, Ottawa, Canada*

ABSTRACT

From its discovery in 1920, the European Corn Borer (*Pyrausta nubilalis* Hub.) has been spreading and now the main corn growing sections of Ontario are infested. Two hundred and twenty-one townships covering approximately 18,180 square miles are qurantined or infested. During the past season there has been a marked increase in the degree of stalk infestation. In certain sections of one county (Essex) the increase in commercial corn amounts to four thousand percent. Commercial losses to corn are taking place in twenty-one townships. In estimating damage, consideration must be given as to whether the corn is grown for fodder, grain, or seed. One canning district suffered severely this past summer. The rate of increase in Essex and Kent Counties has been largely due to the way the corn is handled, few stalks are cut, and ploughing does not usually take place until the following summer. If the rate of increase continues and there is no modification of farm practice, commercial corn growing will have to be abandoned. The farmers in the affected districts are aroused to the seriousness of the situation and committees to deal with the problems have been formed.

From the time of its discovery in 1920, the European Corn Borer has been gradually spreading until now it infests the main corn growing sections of Ontario and with the increase in distribution there has been an increase in the degree of infestation which has been most marked this past season. In fact, the situation in the corn growing counties of Essex, Kent and Lambton has assumed a most serious aspect.

In 1920, when scouting work for this insect was carried on for the first time, thirty-five townships covering 2,780 square miles were found to be infested, this area has been added to each year so that by the fall of 1924 we have two hundred and twenty-one townships in Ontario

covering approximately 18,180 square miles, which are actually infested or have been included in the quarantined area for economic causes. The quarantined area may be stated briefly as including all the territory in the southern Ontario peninsula from the Georgian Bay to Toronto and the townships bordering Lake Ontario and the St. Lawrence river as far east as Trenton.

During the summer of 1924, only five additional townships were found infested, these bordered the north-eastern shore of Lake Ontario. Scouting as such, was not carried on in the north-western section adjacent to the 1923 infested area, in view of the fact that this territory was all included in the quarantined district when the regulation was amended in the spring of 1924, but for a matter of record this area was examined to determine the northern spread, and an infestation was located in Aran township, Bruce county. This outbreak is the most northern one in Canada and approximately one hundred and fifteen miles north of St. Thomas.

Increase in Infestation

In 1922, it was decided to select a number of definite points in the infested area with the idea of determining the increase or decrease of the intensity of infestation from year to year. Owing to the lateness of the season when this work started data from only a few points in the older infested area were secured. In 1923, a definite system was worked out. Points were selected at more or less regular intervals on three concentric circles, seven, fifteen and thirty miles respectively, from Union Village, Elgin county, as the centre and which was the centre of the original heavy infestation, and in addition, several points in the outlying counties. A total of one hundred and eight locality points were used in 1924. At each point three hundred corn stalks in each of the five corn fields nearest to the "point" were examined, no regard was paid to the variety of corn, date of planting, or commercial value of the crop in the selection of the fields, although this information was secured for other purposes, that is the commercial aspect of the case was not considered in securing these records.

In order to show the increase in infestation of the European Corn Borer in the season of 1924 as compared with 1923, the following summary averaging the degree of stalk infestation in the various circles and counties may be used. Circle No. 1 shows an increase of one hundred per cent, circle No. 2 one hundred per cent, Circle No. 3 three hundred per cent, Essex county nine hundred per cent, Huron county three hundred and fifty per cent, Lincoln county one hundred per cent, Nor-

folk county seven hundred per cent, Oxford county three hundred per cent, and Welland county one hundred and fifty per cent.

The Increase in Infestation and its Economic Effects

The above records although indicating a general increase in stalk infestation are not intended to imply that commercial loss is being felt throughout the entire infested area. The amount of actual infestation varies in different counties and also in townships within a county. But the enormous increase that has taken place within the corn growing county of Essex is most significant. In some sections of this county the actual increase in commercial corn amounts to four thousand per cent. A general survey of the infested area reveals the fact that actual commercial losses are taking place in twenty-one townships, these are located in Oxford, Elgin, Middlesex, Kent and Essex counties, where the infestation varies from fifty to one hundred per cent.

In estimating damage, consideration must be given as to whether the corn is grown for fodder, grain or seed. Fodder corn may have seventy-five per cent of the stalks broken over, and although extra labour would be entailed in harvesting, the actual farm loss would probably be less than twenty-five per cent. In corn grown for grain the loss would be higher, due to the injured stalks affecting the development of the ear, larval feeding and loss of grade. In the case of seed corn the crop might readily be a total loss, especially where the market calls for seed corn on the cob.

There is only one canning district seriously affected as yet, during the past season twenty-five per cent of the contracted acreage was refused at the factory on account of the severe European Corn Borer infestation, this meant a direct loss to the grower. In handling the balance of the crop the farmer was required to cull the corn before drawing it to the factory, the mechanical huskers were abandoned, and extra staff engaged for hand husking, selecting, and cutting off infested portions of the cob.

Control

The rate of increase has been more rapid in Kent and Essex which are grain and seed corn counties, this has undoubtedly been due for the most part to the farm practice generally followed, large quantities of stalks are left undestroyed, the grain is husked in the field, and the stubble left undisturbed the first year. The recommendations for control urged for districts where sweet and fodder corn is grown, cannot be readily carried out. The individual acreage is greater, for corn is the main crop, it is in these two counties that the Canadian grain corn is

largely grown. The value of every acre of farm land is directly influenced by the fact that corn can be grown, easily and profitably. If the corn borer increases at one-half the rate for the next three years that it has increased in the past three, corn growing as a commercial crop will be a thing of the past in these counties, and the value of farm land will drop thirty-five to fifty dollars per acre. The farmers themselves are thoroughly awakened to the seriousness of the situation, committees have been formed in each township, under the direction of a county committee, which in turn is under a general provincial executive committee. The problem is how to dispose of infested corn refuse in such quantity that it is impossible to feed it, and with the individual acreage so large that ploughing is out of the question. The solution is not easy, but it appears that it will involve the modification of present farm practise, and the utilization of mechanical contrivances for the destruction of the refuse after the grain is harvested.

The next paper is by D. J. Caffrey.

STATUS OF THE EUROPEAN CORN BORER IN THE UNITED STATES IN 1924

By D. J. Caffrey, *European Corn Borer Laboratory, U. S. Bureau of Entomology, Arlington, Mass.*

Abstract

During 1924 the European corn borer, *Pyrausta nubilalis* Hübn., increased the area of its distribution in the United States from 16,052 square miles to 24,773 square miles. The greater part of this dispersion occurred in the stragetic area west and south of Lake Erie and advanced the pest well into the heavy corn producing regions. In Ohio and Michigan there occurred an increase in intensity of infestation amounting to approximately 258 per cent and in western New York an increase in intensity of approximately 284 per cent. A decrease in intensity of approximately 20 per cent occurred in New England. No increase of territory in eastern New York nor in the main New England area. The increases in the single generation western areas are believed to be chargable to favorable weather conditions while the decrease in the two generation area of New England is probably chargeable to the culminative effect of unfavorable weather conditions existing in 1923 and 1924 plus the very thorough clean up and plowing operations under the stimulus of the Massachusetts state law.

Insectary experiments and field observations in Ohio indicated a larval survival of 10 per cent, based upon number of eggs deposited.

The necessity of cutting corn as low, and as early in the season as possible, was forcibly demonstrated by observations showing that the percentage of larval population, left in 6 inch stubble from stalks cut during early November was three times greater than in stubble of the same height cut during mid-September.

Varieties of corn characterized by large stalks and ears have exhibited a greater

resistance to *severe* injury by the corn borer than varieties possessing small stalks and ears. None of the varieties tested to date possessed practical immunity from attack. In Ohio and Michigan the percentage of stalk infestation in sweet corn was slightly greater than in field (dent) corn while the larval population in sweet corn was more than double that in field corn. In this same area but very little injury developed in fields of sweet or field corn planted after the first week of June. Early sweet corn as a trap crop failed to function under 1924 conditions.

Clean plowing, especially during the late autumn, is recommended for infested crop residues which are impractical to eliminate by burning or feeding. Two per cent free nicotine dust gave encouraging results during 1924 when applied at the period of maximum egg hatching.

A total of 1,168,276 foreign parasites, consisting of seven different species, have been liberated in the United States. Two of these species have been recovered in the field.

European observations during 1924 showed that the corn borer is a pest of prime importance in the principal corn growing region of Hungary, where conditions are similar to those existing in the Corn Belt of the United States.

During the season of 1924 the European corn borer, *Pyrausta nubilalis* Hübn., increased the area of its distribution in the United States from 16,052 square miles to 24,773 square miles; an increase in area of 54.33 per cent. The greater part of this dispersion occurred in the Lake Erie-Lake Ontario section of the states of Michigan, Ohio, Pennsylvania and New York. The advance of the corn borer westward into the essentially dent corn producing regions of Ohio and Michigan is particularly important and brings the pest to within 45 miles of the Indiana state line. Southward the dispersion was also very pronounced in Ohio and Pennsylvania and extended across the water-shed to a maximum distance of 50 miles south of Lake Erie. In the eastern New York area and in New England, scouting operations failed to disclose any increase in territory invaded by the insect during 1924, with the exception of a series of scattered infestations in four townships along the shoreline of Connecticut. Limited infestations were also discovered during 1924 on the northeastern side of Staten Island, just across the channel from the Brooklyn area, and at Little Neck, Long Island. The specimens found on Long Island, Staten Island and in Connecticut were collected from weeds, as well as from corn, and since two generations annually were indicated by the finding of summer pupation, the presence of the corn borer in this region has assumed a serious aspect, particularly in view of the proximity of the extensive sweet corn and seed corn producing centers of Connecticut, Long Island and New Jersey.

When the corn borer was discovered in New England during the summer of 1917 a preliminary survey by Vinal[1] showed that approxi-

[1]1917 Vinal, S. C. The European Corn Borer, Bull. 178, Mass. Agri. Exp. Station, p. 149.

mately 100 square miles were infested. Table I shows the annual dispersion as determined by Mr. Worthley's scouting operations during the seven-year period since 1917, including the areas of original infestation in eastern and western New York.

TABLE I. ANNUAL DISPERSION OF THE EUROPEAN CORN BORER IN THE UNITED STATES (SQUARE MILES).

Year	New England	New York (East)	New York (West)	Penn.	Ohio	Michigan	Total area (Sq. mi.)	Increase (per cent)
1918	794						794	
1919	1987	849	505	32			3373	324.81
1920	2408	1375	966	do			4781	41.74
1921	2825	2253	1659	302	738	83	7860	64.40
1922	5130	2882	3554	613	1408	271	13858	76.31
1923	5661	do	3871	653	2553	432	16052	15.83
1924	do	do	4812	1999	6591	2828	24773	54.33

COMPARISON OF INFESTATION IN 1923 AND 1924

The widespread dispersion of the borer in the Lake Erie section during 1924 was accompanied by an increase in intensity of infestation in Ohio and Michigan which amounted to 258 per cent, as shown by comparable field surveys conducted in 1923 and 1924. A comparison of these surveys is summarized in Table II.

TABLE II. COMPARATIVE INFESTATION OF THE OHIO-MICHIGAN AREA IN 1923 AND 1924.

Year	Number of fields exam.	Per cent stalks infested — (average)	Average number larvae per inf. plant.	Average larvae per 100 plants	Per cent increase in intensity (larval population)
1923	133	1.83	1.41	2.58	
1924	241	5.28	1.75	9.24	258.14

Maximums were recorded of 52 per cent in stalk infestation in sweet corn and 33 per cent stalk infestation in dent field corn during 1924 as compared to a maximum of 17 per cent in 1923. Especially noteworthy was the increase in ear infestation throughout this region, and appreciable economic loss occurred in the more heavily infested fields.

A comparison of the results of similar field surveys conducted in western New York for the last two years indicates an increase in intensity of infestation in that area of 284 per cent during 1924. This comparison is summarized in Table III.

TABLE III. COMPARATIVE INFESTATION OT THE WESTERN NEW YORK AREA IN 1923 AND 1924

Year	Number of fields exam.	Per cent stalks infested — (average)	Average number larvae per inf. plant.	Average number larvae per 100 plants	Per cent increase in intensity (larval population)	Per cent ears inf.	Per cent stubble inf.
1923	32	15.16	1.30	19.75		5.50	6.63
1924	39	27.79	2.72	75.79	283.75	9.04	10.06

It will be noted that the percentage of increase in intensity of infestation in western New York coincided quite closely with that for Ohio and Michigan. The percentage of ear infestation in western New York showed a notable increase during 1924, maximums of 42 per cent being recorded in dent field corn and 33 per cent in sweet corn with an average of 9 per cent in 39 fields as shown in Table III. The presence of the borer in sweet corn ears is becoming a serious factor to the canning interests in and near Silver Creek, N. Y., where an average of 11.9 per cent of the ears delivered to one factory were found to contain the borer.

The 1924 field survey in New England indicated that in the fields under observation there had occurred a *decrease* in intensity of infestation amounting to 20 per cent, when compared to a similar survey conducted during 1923 in the same or near-by fields. In general this decrease was most pronounced in the older portion of the infested area while the fields near the outer margin of the area exhibited increases. Table IV summarizes the most important points brought out in these surveys.

TABLE IV. COMPARATIVE INFESTATION OF THE NEW ENGLAND AREA IN 1923 AND 1924.

Year	Number of fields exam.	Per cent stalks infested — (average)	Average number larvae per inf. plant.	Average number larvae per 100 plants	Per cent *decrease* in intensity (Larval population)	Per cent ears infested* (sweet corn)
1923	246	17.2	2.9	49.9		10.6
1924	178	18.2	2.2	40.0	19.8	1.2

*Based upon an examination of the sweet corn ears at harvest in 66 fields during 1923, and in 52 fields during 1924.

The decrease of infestation in sweet corn ears at harvest was very pronounced as compared to conditions existing in preceding years, while the per cent of infestation and the larval population decreased remarkably in vegetable crops, field crops, flowers and weeds.

Probable Factors Involved in 1924 Developments

Relative to the probable causes contributing to the increased infestation in the Lake Erie section, it may be stated that studies to determine the factors involved are still in progress, but the information now available indicates that excessive precipitation during June provided excellent conditions for the overwintering larvae preparatory to pupation, whereas the prevalence of heavy dews and high humidity, in the absence of heavy rains, during the period of oviposition, incubation and early life of the larvae, permitted large numbers of the young larvae to become established. That the climatic conditions were more favorable for egg deposition during 1924 than during the preceding year was indicated by cage experiments at both the Sandusky, Ohio and Silver Creek, N. Y., laboratories, wherein the average total eggs deposited by each female in the 1924 series exceeded the 1923 average at Sandusky by 82 per cent and at Silver Creek by 62 per cent, as shown in Table V.

Table V. Comparative Reproduction. Oviposition Records of 1923 and 1924, Lake Erie Section

Year	Average days oviposition period		Average total eggs per female		Average egg clusters per female		Average eggs per cluster		Average longevity of females	
	S. C.[1]	Sand[2]	S. C.	Sand.	S. C.	Sand.	S. C.	Sand.	S. C.	Sand.
1923	12.5	6.5	218	321	18.9	24.0	14.5	13.4	24.8	9.6
1924	11.3	14.9	354	585	25.7	37.1	16.6	16.8	22.3	19.7

[1]S. C. = Silver Creek, N. Y.
[2]Sand. = Sandusky, Ohio.

The decrease in intensity of infestation in New England is due apparently to the adverse climatic conditions which prevailed during 1923, and which were repeated during 1924, plus a very thorough clean-up of fields, gardens and weed areas and the fall plowing of practically 90 per cent of the cornfields under the stimulus of the Massachusetts state law compelling such action. The numerical abundance of the larvae had been decreased to such an extent by the Spring of 1924 that it was difficult to obtain sufficient material for parasite rearings and other experiments. This reduction was reflected in the progress of infestation throughout the season.

Larval Establishment and Survival

Cage experiments which were conducted at Sandusky, Ohio, to determine the percentage of larval establishment and survival showed that an average of only 6.04 per cent of the eggs developed into fully

grown larvae in instances where such eggs were deposited upon growing corn plants by females confined temporarily in large cages. That this percentage of survival was lower than that prevailing in the field was indicated by an analysis of 159 isolated infestations found in Ohio and Michigan cornfields wherein an average of 1.70 borers were collected per infestation. Since each of 736 egg-clusters collected in these fields earlier in the season contained 15.6 eggs, on an average, the survival of 1.70 borers per infestation shows that 10.9 per cent of the eggs deposited in the field developed into fully grown larvae; assuming that each of the isolated infestations developed from a single egg cluster.

Whether the percentage of larval survival during 1924 was higher than normal, and thus contributed to the greatly increased infestation in the Lake Erie region, can only be determined definitely by similar studies in succeeding years.

Distribution of Borers in Stubble

Continued studies relative to the seasonal distribution of the borers in that part of the stalks which are commonly allowed to remain in the field as stubble, have shown conclusively the necessity of cutting the stalks low and as early in the season as possible. Examinations which were made in field (dent) corn in Ohio during the period between September 10 and November 3, 1924, showed a pronounced movement of the borers to the lower part of the stalks so that on November 3, 74.5 per cent of the borer population remained in 24-inch stubble, 41.8 per cent in 12-inch stubble and 22.7 per cent in 6-inch stubble. Details of these examinations are shown in Table VI.

Table VI. Percentage of Borers in Stubble in Ohio, September 10 to November 3, 1924

Date of Examinations	Number of larvae observed	Per cent larvae in 24-inch stubble	Per cent larvae in 12-inch stubble	Per cent larvae in 6-inch stubble
Sept. 10–16	547	30.7	16.6	7.3
Sept. 16–25	226	37.6	20.4	10.2
Oct. 1– 9	173	45.1	23.7	8.7
Oct. 23	135	68.2	38.5	17.0
Nov. 3	110	74.5	41.8	22.7

It is believed that the greater proportion of the corn stubble in the machine-cut fields of Ohio and Michigan is at least 6 inches in height while 24 inches is about the maximum in fields cut by hand methods. Considering the high percentage of borers remaining in stubble cut as

low as 6 inches, late in the season, it is evident that low and early cutting should be stressed.

Varietal Selection and Time of Planting

The planting projects relating to the influence of varietal selection and time of planting, as applied to the principal types of corn, were continued during the past year by the Bureau at Silver Creek, N. Y., and in cooperation with the Experiment Station agronomists at Sandusky, Ohio, and Waltham, Massachusetts.

In general the results relative to varietal selection were similar to those obtained in preceding experiments. None of the varieties tested to date have shown any indication of possessing practical immunity from attack, although the varieties characterized by large stalks and ears have shown a greater resistance to *severe* injury than varieties possessing smaller stalks and ears, and exposed to similar conditions of infestation, even when the larger varieties were carrying an equal, or a greater, larval population.

The experimental field results relative to time of planting varied considerably from the results secured in preceding years, due probably to the vagaries of the season. In general, however, the plots of field or sweet corn planted before the last week of May, in the single-generation areas, sustained greater injury than the plots planted later, while plantings made after June 10 sustained little or no injury. In the two-generation area of New England the early and late plantings sustained the heaviest infestations, irrespective of type or variety.

Concerning the comparative susceptibility of field and sweet corn in the field, an analysis of the 1924 field surveys show that in the 241 fields examined in Ohio and Michigan the average stalk infestation in sweet corn exceeded that in field (dent) corn by 1.40 per cent (6.36 per cent–4.96 per cent), while the larval population in sweet corn (16.00 larvae per 100 stalks) was more than double that found in field corn (7.28 larvae per 100 stalks). In the 39 fields surveyed in western New York, however, the stalk infestation in field (dent) corn exceeded that found in sweet corn by 5.3 per cent (29.2 per cent–23.9 per cent) while the larval population in each *type* was approximately the same. The percentage of ears infested, however, was about three times as great in sweet corn (11.4 per cent) as compared to the ear infestation in field corn (3.9 per cent).

Relative to the influence of time of planting, as observed in Ohio and Michigan fields where accurate information upon the date of planting could be secured, the results of the field survey showed that sweet

corn planted during April sustained the maximum infestation and injury. Plantings made during May showed a progressingly decreasing injury as they were advanced during the month, while in fields planted after the first week of June very little injury resulted. In field corn the fields planted during the fourth week of May showed the maximum infestation and late plantings after June 6 showed less than one per cent infestation. The details of this analysis are shown in Table VII.

TABLE VII. INFLUENCE OF TIME OF PLANTING ON INFESTATION AND INJURY, OHIO AND MICHIGAN, 1924

Type	Dates of planting	Number of fields exam.	Per cent stalks inf.	Aver. number larvae per inf. stalk	Number larvae per 100 stalks
Sweet Corn					
	4/19–4/26	8	13.90	2.92	40.50
	5/1 –5/10	12	7.35	2.40	17.65
	5/12–5/20	11	6.60	2.14	14.13
	5/22–6/2	9	6.16	2.36	14.55
	6/4 –7/3	11	1.82	1.88	3.43
	7/4 –7/15	2	0	0	0
Field Corn					
	5/9 –5/12	9	4.27	2.20	9.42
	5/18–5/23	10	1.97	2.30	4.53
	5/26–5/31	22	8.13	1.54	12.52
	6/1 –6/6	15	1.26	1.75	2.21
	6/13–6/20	4	0.91	1.77	1.61

Although the earliest planted fields of sweet corn contained the greatest larval population and substantiated the possibilities of using early sweet corn as a trap crop in Ohio, a series of special observations in the immediate vicinity of 19 early planted sweet corn fields of Ohio failed to demonstrate that the trap crop method gave any appreciable benefit under the conditions existing during 1924.

PLOWING

Studies to determine the effects of fall or spring plowing have been continued at Sandusky, Ohio, and Silver Creek, N. Y. Infested stalks and stubble plowed down late in th fall of 1923 showed a greater degree of migration of larvae to the surface the following spring (1924) than had been encountered in similar experiments during preceding years. In general, however, the percentage of larvae recovered at the surface from late fall plowing was less than from early fall or spring plowing, and judging from results secured to date it appears that late fall plowing

should be stressed. In experiments conducted during the fall of 1924 the percentage of larvae recovered at the surface was less in early fall plowings (September 17 and 20) than in strips plowed during the period from September 27 to October 25. In plowings made after the first week of November there occurred a most decided decrease in percentage of larvae migrating to the surface and none were recovered from strips plowed during the last week of November or early in December. The percentage of larvae migrating to the surface in the spring of 1925 from these late fall plowings will give an indication of the value of this control method.

Based upon the results of the plowing experiments to date, it appears that clean plowing, especially during the late fall, is to be recommended for the destruction of cornstalks and corn stubble remaining in the field and other corn refuse within infested areas which are impractical to eliminate by burning or feeding.

Field observations have shown that the effectiveness of clean fall plowing can be nullified to a great extent by subsequent cultivation which drags large quantities of the plowed under material to the surface. This can be avoided by the use of a disc cultivator, disc drill and whenever possible, by the use of a crop not requiring deep cultivation in the spring.

Insecticides

The experiments pertaining to insecticides during 1924 gave promising results with dusts containing 2 per cent free nicotine. When this dust was applied to early sweet corn a percentage of control varying from 15 to 85 per cent was secured. Two plots of late sweet corn, dusted twice with 2 per cent free nicotine dust, under maximum conditions of infestation gave percentages of control based upon ear infestation, of 67 per cent and 74 per cent respectively. The cost of these experimental treatments was approximately $11.00 per acre. Based upon the results of our experiments to date, we believe that nicotine dust, containing 2 per cent or more of free nicotine, are effective in limiting injury to valuable crops of corn, when the application of such dust is gauged to coincide with the maximum period of egg hatching.

Parasites

During the past year additional shipments of foreign parasites originating in France and Italy were received from the Hyeres, France, laboratory. These importations from abroad have been augmented by breeding campaigns at the Arlington laboratory each year and a total

of 1,106,926 foreign parasites, consisting of seven different species, have been liberated in New England since 1919. In 1924 a total of 33,470 consisting of two of the more promising species, were liberated in Ohio and 27,880 individuals of the same two species were liberated in western New York. The total liberations of foreign parasites are listed in Table VIII.

TABLE VIII. LIBERATIONS OF FOREIGN PARASITES OF THE EUROPEAN CORN BOREP IN THE UNITED STATES

Species	Number of parasites liberated		
	New England	New York (West)	Ohio
Zenillia roseanæ B. and B.	874		
Eulimneria crassifemur Thom.	5,860		
Angitia punctoria Roman.	733		
Habrobracon brevicornis Wesm.	1,054,400	25,000	25,550
Exeristes roborator Fabr.	40,335	2,880	7,920
Microgaster tibialis Nees.	3,264*		
Phæogenes planifrons Wesm.	1,460		
Totals.	1,106,926	27,880	33,470

*Includes 2,815 parasitized larvæ.

Although it has not been possible to stage an extensive campaign for the recovery of the liberated species, with the exception of *Habrobracon brevicornis*, two species, *Exeristes roborator* and *Microgaster tibialis*, have been recovered during the progress of incidental collections in New England, the former during 1923 and 1924 and the latter during 1924. These recoveries have been made under circumstances which lead us to hope that these two species, at least, will become established in America. None of the other species have been recovered in the field to date.

Dr. W. R. Thompson, in charge of the Hyères, France, laboratory, has reported encouraging facts relative to parasitism of *P. nubilalis* in certain areas of France and Italy. Large-scale collections of corn borer larvae in the Paris region last winter showed a parasitism by *Microgaster tibialis* of better than 20 per cent. Mr. K. W. Babcock found 19.5 per cent of the overwintering larvae parasitized by *Habrobracon brevicornis* at Mezöhegyes, Hungary. These and similar data on other listed parasite species enable us to conclude that special stress must be placed upon increased importation of parasites and their establishment throughout our rapidly expanding areas of infestation.

European Observations During 1924

Mr. K. W. Babcock of the Arlington, Mass., laboratory has submitted recently a very excellent report detailing the more important facts brought out in his preliminary investigations of the corn borer situation in Europe during the past season, with special emphasis upon the seasonal history, economic status and distribution of the insect in Hungary, Italy, France, Austria and Germany. With the limited time and assistance at his disposal Mr. Babcock determined that the corn borer was distributed widely throughout the countries mentioned above and that in 1924 it caused serious damage to corn in restricted districts of the Great Plain of Hungary and in a few fields of northern Italy. Throughout most of the territory examined the insect did not occasion serious losses during the past season.

According to Mr. Babcock, that part of central and southern Hungary lying between Békes and Novi Sad was practically the only region observed, or reported, during 1924 where the corn borer caused serious interference with the growth of corn. Detailed studies of the actual loss caused by the borer in this region showed an average estimated loss of 23.9 per cent in 38 fields in the vicinity of Mezöhegyes; 18.9 per cent loss in 12 fields near Novi Sad; 18.4 per cent loss in 19 fields at Bankut and losses ranging from 14.2 per cent to 5.5 per cent in other districts of this region. The infestation was distributed indiscriminately in dent and flint corn with maximums of 100 per cent stalk and ear infestation in certain fields of each type. In general the flint varieties and a white dent known as "Padua White" appeared to be more susceptible than the yellow dent varieties which predominated in the corn-growing areas studied. The "Padua White Dent" is now being rapidly displaced by other varieties, usually one of the yellow dents, owing to its susceptibility to corn borer injury. A combination of fungus and borer injury was rather widespread throughout southern Hungary during 1924 and in the majority of instances where the grain had been injured by the borer the fungus developed and rendered the injury more serious. It should be noted that these studies were conducted in a region where dent corn predominates and which in many respects resembles closely the conditions existing in our Corn Belt. The losses sustained to dent corn in Hungary seem particularly significant as applied to possibilities of damage in the United States.

No systematic methods of control, or cultural practices used with the definite idea of control, were observed by Mr. Babcock during his European observations, with the possible exception of the abandonment

of susceptible varieties of corn. In the northern and northwestern areas of Hungary the farming in general is cleaner than in the south, and the crop residues are burned each fall, while in the south they are allowed to accumulate in stacks from year to year. During the past season, at least, the areas where clean culture was practiced corresponded with the areas of least infestation.

The last paper of this series is by L. L. Huber.

ON CERTAIN BEHAVIOR OF THE EUROPEAN CORN BORER (*PYRAUSTA NUBILALIS* HUBN.)

By L. L. Huber and C. R. Neiswander, *Department of Entomology, Ohio Agricultural Experiment Station*

Abstract

This paper consists of an account of the behavior of more than 270 European corn borer (*Pyrausta nubilalis* Hubn.) larvae when subjected to certain artificial conditions. These larvae were confined in wire cloth cages before and at the regular time for natural pupation. In each cage was a group of clods and a quantity of sand. The borers, therefore, could pupate either in the sand, in or under the clods, or on the sides of the cages. A comparatively large number pupated in the clods and sand and a part of these emerged as adults.

It is perhaps unnecessary to mention again that within a few days after fodder infested with the European corn borer (*Pyrausta nubilalis* Hubn.) is plowed under in the early fall or in the spring, practically all of the borers will begin to come to the surface, the rapidity of their movements evidently being influenced by the weather and soil conditions. At this point there arises a perplexing question, namely, What then becomes of the borers? It has been shown that the disappearance of many of them may be connected with the activity of birds, ants, beetles and other predaceous forms. It has also been demonstrated that under certain conditions appreciable numbers may migrate from the field after it is plowed, going to the weeds and rubbish in fence rows. However, if the field be large, the majority must necessarily remain in it. This paper offers preliminary evidence of what may happen to some of those that remain in the field.

In short, we have sought information on what might be the fate of borers that found themselves in a theoretically clean field; i. e., a field in which the plowing has been so thoro that not only is all fodder buried but the stems and roots of grasses and weeds are likewise well covered. Under controlled conditions an experiment simulating such a field was carried on during the past summer.

On a bed of lake sand three inches deep were placed several groups of clods of earth ranging from one to three inches in diameter and composed of a heavy clay loam. These groups averaged about one dozen clods each. Each group of clods was then covered with a small screen cage measuring about one foot square and eight inches high. Directly after the borers were liberated on each group of clods the cage was pushed down into the sand about two inches in an attempt to prevent the escape of the borers.

It is quite true that the cage and its contents represented an extreme condition. Care was exercised to have the contents entirely free from all kinds of debris. In their search for pupation quarters the borers had their choice of the sand, the clods, or the sides of the cage.

Twenty-five borers were placed in each of nine cages. Each week, beginning June 5, one cage was opened and observation made. A total of one hundred and forty-two borers were recovered from the total of two hundred and twenty-five used at the beginning; sixty-three borers, therefore, were missing. The missing ones are accounted for as follows: (1) There was evidence that some borers in the cages had disintegrated, especially in the cages that were observed last, (2) Several borers were recovered in strips of corrugated paper that had been placed around the cages; (3) It is probable that many borers did not seek shelter in the corrugated paper traps and hence escaped permanently.

Of the one hundred and forty-two specimens recovered, seventy-four were below the surface and sixty-eight above the surface, i. e., on the sides of the cages. Of the seventy-four below the surface there were *alive* in the sand thirty-three larvae and five pupae, and in the clods ten larvae and six pupae, a total of fifty-four. A total of twenty were found dead below the surface; of these, seventeen were larvae and one pupa in the sand, while one larva and one pupa were found in clods. From the pupae found in the sand and clods five moths emerged. It may be of interest to note that one of these moths deposited a total of 659 eggs. Perhaps the percentage of moths emerging would have been larger if the pupae had not been handled during observation of the cages.

In another cage in the form of a cone a similar group of clods was placed on a bed of sand. These clods ranged from two to five inches in diameter. Forty-eight borers were liberated in this cage on July 9 or after the peak of emergence for 1924. The fact that the time for normal pupation was past, together with the fact that the clods were much larger, may explain in part the higher percentage of pupation and emergence.

Examination of this cage one week later showed that eighteen larvae had either died, escaped or had pupated on the cage itself; twenty-three had pupated in the sand; and seven had pupated in the clods. Later observation showed that fourteen moths had emerged from those larvae that had pupated in the sand and four moths from those pupated in the clods. Thus a total of eighteen moths emerged from the thirty specimens that pupated in the sand and clods.

Due not only to the fact that these data were secured from so few larvae, but also that the tests were carried on under controlled conditions, no conclusions are drawn. These experiments are only preliminary; further research is in progress.

PRESIDENT A. F. BURGESS: We have now completed a series of three papers concerning the European Corn Borer and they are open for discussion.

MR. E. P. FELT: I would like to ask Mr. Caffrey if he has any recent data respecting the causes which have produced the distribution around Lake Erie, in particular.

MR. D. J. CAFFREY: No, there is no special data except the tendency of corn borer dispersion to be affected locally by the presence of a large body of water. For instance, the tendency of the north wind to distribute the borers farther south in the Lake Erie section. Whether that had anything to do with the dispersion this year or not, we do not know.

MR. E. P. FELT: Do you think it may have?

MR. D. J. CAFFREY: Yes. In some quarters it has been felt that the distribution of the corn borer was influenced by the presence of bodies of water, but that doesn't hold true when we reflect upon the distribution of the corn borer in Europe. I do not feel that the presence of a large body of water has any influence upon the *general* distribution of the borer.

PRESIDENT A. F. BURGESS: The next is a paper by W. P. Flint and C. C. Compton.

A NEW METHOD FOR CONTROLLING THE ONION MAGGOT

By W. P. FLINT, *Entomologist*, and C. C. COMPTON, *Asst. Entomologist*,
Natural History Survey, Urbana, Illinois

ABSTRACT

Two methods of control of *Phorbia ceparum* have been found effective.

(1) Moistening the onions with corrosive sublimate solution.

(2) Use of Bordeaux oil emulsion. Practically complete control was obtained by the latter method this year when maggots caused a loss of at least 50% of the onion crop.

Over eighty per cent of the onion sets used in the United States are grown in an area adjacent to Chicago, laying mainly in Cook County, Illinois, the annual value of this crop being around a million dollars. The onion maggot, and onion thrips are the two worst insect pests of onions in this area. On the average, the loss from the onion maggot amounts to between ten and fifteen per cent of all set onions grown, and in years when the insect is particularly abundant, the damage will reach to from 35 to 50% of the crop. During the past seven years experimental work has been carried on in this area to develop better methods of control. The field work for the past three years has been in charge of Mr. Compton, and the earlier work under Mr. F. M. Wadley. In the course of the experimental work, a number of tests were made with different substances applied directly to the young onions which it was hoped would prove effective as ovicides, larvacides, or repellents to the adult flies. Two classes of materials have been used, liquids and dusts.

The general method of procedure in this work has been to apply the insecticide directly to the young onions in the row, making from 3 to 5 applications, depending somewhat on the abundance of the maggot. The first application was usually made when the onions were about one inch high, with subsequent applications at seven to ten day intervals. The applications of dust were made with hand dusters of the blower type treating one or two rows of onions at a time. The applications of the liquids were made in a fine stream thru a small hose directly upon the onions and in sufficient amount to wet the ground for about one inch on each side of the onion plants, or sprayed over the plants in the case of the Bordeaux oil emulsions. In all cases, the onions were dried in the usual manner, and graded by the men who do this work for the onion growers. The yields in all cases given are for the set onions, the oversized onions which are of little value to the grower having been screened out before the yields were taken. Before 1922, the work was carried on in row plots, for the past three years in plots one-twelfth of an acre in size.

In the tests conducted in 1922, corrosive sublimate used in solution, alone, or with Bordeaux, and Bordeaux mixture alone, gave the best results. The onion maggot was not very abundant during that season.

Results of Experiments, 1922

In addition to these materials, a number of other combinations of Bordeaux and corrosive sublimate were used, but none of these gave greater increases in yield than those mentioned.

TABLE I

Treatment	Application	Yield in Bu. per acre
	3 applications	
Corrosive sublimate, 1 ounce to 10 gallons of water	10 day intervals	529.8
Bordeaux mixture (4–4–50) as liquid	" " "	538.1
Bordeaux dust	" " "	438.7
Nicotine dust (2%)	" " "	485.6
Sulphur nicotine dust	" " "	435.9
Bordeaux mixture (4–4–50) 1 ounce corrosive sublimate to 10 gallons of water	" " "	521.
Check, untreated		448.

In 1923, this work was continued in the same area, using in addition several new materials including Bordeaux lubricating oil emulsion. (*Boiled lubricating oil emulsion 2% in 4–4–50 Bordeaux mixture.*)

RESULTS OF EXPERIMENTS, 1923

TABLE II

Treatment	Application	Yield in Bu. per acre
	3 applications	
Corrosive sublimate, 1 ounce to 10 gallons of water	10 day intervals	514.
Bordeaux, lubricating oil emulsion	" " "	468.
Nicotine dust	" " "	344.
Bordeaux mixture	" " "	329.8.
Mercuric cyanide[1]	" " "	323.
Green Copper Dust	" " "	214.
Check, untreated		325.

[1]Low yield partly due to the fact that this mixture was used too strong, i.e., 1 ounce in 20 gallons of water.

During 1924, a very severe outbreak of the onion maggot occurred in this area giving an excellent opportunity to check on the results of the treatments which had previously seemed effective. Many of the fields in the immediate neighborhood of those in which our plots were located, were so heavily infested by the onion maggot that they were plowed up prior to the first of August.

RESULTS OF EXPERIMENTS, 1924

TABLE III

Treatment	No. of applications	Interval between applications	Gallons used per application per acre	Yield in Bu. per acre
Corrosive sublimate 1–10 (1)....	3	10 days	200	220.2
Corrosive sublimate 1–10 (2)....	3	10 "	600	275.0
Bordeaux oil emulsion 1%.....	5	7 "	115	412.8
Bordeaux oil emulsion 2%.....	5	7 "	115	681.3
Bordeaux oil emulsion 3%.....	5	7 "	115	627.9
Check.....				44.2

During the past season, Mr. Compton has carried on some cage experiments to test the actual effect of corrosive sublimate solution, and the Bordeaux oil emulsion, on the different stages of the onion maggot.

Tests in which sprayed, and unsprayed onions were exposed to adults of the onion maggot showed Bordeaux oil emulsion had no marked repellent effect in reducing oviposition of the flies on the sprayed onions. Treatments of the eggs and larvae of different sizes with the mixtures which have given the best results in our field tests showed a high percentage of kill from both oil emulsion, and corrosive sublimate solution when sprayed upon the eggs and young larvae, but neither of these materials were very toxic to the nearly full grown larvae.

SUMMARY OF EXPERIMENTS ON IMMATURE STAGES OF THE ONION MAGGOT

						% kill
Corrosive sublimate						
1 oz. to 10 gals. of water	Eggs treated	60	Per cent hatched	3.4	96.6
" " " " " "	¼ grown larvae	60	" survived	37.4	66.0
" " " " " "	½ " "	60	" "	65.	35.0
" " " " " "	Full" "	60	" "	90.	10.
Bordeaux oil emulsion 1%	Eggs	60	" hatched	40.	60.
" " " "	¼ grown larvae	60	" survived	74.4	26.6
" " " "	½ " "	60	" "	83.4	16.6
" " " "	Full" "	60	" "	99.5	.5
Bordeaux oil emulsion 2%	Eggs	60	" hatched	10.	90.
" " " "	¼ grown larvae	60	" survived	46.7	53.3
" " " "	½ " "	60	" "	83.4	16.6
" " " "	Full" "	60	" "	99.	1.
Bordeaux oil emulsion 3%	Eggs	60	" hatched	0.	100.
" " " "	¼ grown larvae	60	" survived	30.	70.
" " " "	½ " "	60	" "	56.7	43.3
" " " "	Full"	60	" "	75.	25.
Check, untreated	Eggs	60	" hatched	99.	1.
" "	¼ grown larvae	60	" survived	100.	0
" "	½ " "	60	" "	100.	0
" "	Full" "	60	" "	100.	0

Examinations of onions at harvest time to show the approximate infestation by second and third brood maggots in the treated and untreated plots showed that the effect of the early treatments were still very apparent. The corrosive sublimate plot having 21% of the onions infested, the Bordeaux oil emulsion 8%, and the check, 49%.

As to the practicability of treatment, cost figures show an expense of material and labor for treating with corrosive sublimate of approximately $17.50 per acre for each application where 600 gallons of the

solution of 1 ounce of bichloride of mercury to 10 gallons of water was used, $6.85 per acre per application for a 2% Bordeaux, oil emulsion where 115 gallons of the material per acre was used, or a total cost for the season for three applications of the corrosive sublimate of $52.50 per acre, and for five applications of the Bordeaux oil emulsion of $35.25 per acre.

Growers in this section are in the habit of using small garden tractors for sowing and cultivating their onions, and it has been found possible to attach a twenty gallon tank to one of these tractors from which the insecticide may be directed to three rows of onions at a time. Applied in this way, the cost of treatment is somewhat reduced from that given. Judging from the results thus far obtained, it is certainly highly profitable, especially in years when the onion maggot is abundant.

PRESIDENT A. F. BURGESS: I think we have all been very much interested in this paper.

MR. G. W. HERRICK: I would like to ask Mr. Flint what is the Bordeaux oil emulsion that he used; that is, what oil was used.

MR. W. P. FLINT: That information is in the paper. I did not read it as the time was so short that I had to abstract the paper.

MR. W. W. YOTHERS: I would like to ask if you can spray the onions without the oil.

MR. W. P. FLINT: Yes, and with quite as good results although we are not satisfied on that point yet. Further experiments are to be carried on along that line.

MR. J. S. HOUSER: I would like to ask Mr. Flint how much latitude he allows in the time of application; that is, when these applications were made.

MR. W. P. FLINT: I presume you mean in relation to the growth of the onion plant.

The first application is made when the plants are approximately one inch high and the later applications, as you saw from the tables I showed you, were made at seven day intervals, giving five applications.

With regard to the manner in which the applications are made I will say that in our experiments we put on the mixture from a knapsack sprayer, using two-line hose and allowing the material to run down by gravity. This last summer, however, the material was applied in some cases from tanks attached to the garden tractors. Practically all the onion growers in that section use tractor cultivators for planting and cultivating their onions, and it has been found possible to attach a

twenty gallon tank to these tractors and treat three rows at a time. They cultivate three rows at a time and in that way the labor is very little greater than it is just to cultivate the crop.

MR. P. J. PARROTT: I should like to ask Mr. Flint if he has observed that the oil emulsion has any influence on the diseases of onions and other insects such as thrips.

MR. W. P. FLINT: In reply to that I will say that it does have some effect on the onion thrips. We are now conducting some experiments on onion thrips. We haven't got satisfactory control in all cases, but it looks promising.

PRESIDENT A. F. BURGESS: The next is a paper by J. E. Graf.

CLIMATE IN RELATION TO MEXICAN BEAN BEETLE DISTRIBUTION

By J. E. GRAF, *Bureau of Entomology, Washington, D. C.*

ABSTRACT

The Mexican bean beetle, *Epilachna corrupta* Muls., is recognized as a pest of beans in three separate areas in the Northern Hemisphere. These three areas differ widely as regards temperature and moisture, one being typically arid, one humid, and the third an intermediate form with dry winters and heavy precipitation during the summer. The persistence of the insect under these varying conditions leads to the conclusion that those climatic elements consisting of temperature and humidity are not important factors in limiting the distribution of the Mexican bean beetle.

The distribution and seasonal abundance of insects are controlled by many factors, among which may be listed wild and cultivated food plants, suitable hibernating quarters, and climatic conditions. While food plants have an important influence on seasonal abundance and may even limit permanent distribution in some cases, climatic conditions undoubtedly determine the limits of the economic distribution of many insects. From the economic viewpoint, the permanent distribution of an insect may be considered as the area over which the insect may attain injurious abundance at frequent intervals.

Many investigators have attempted to correlate climate with the activity and distribution of animal and plant life. One of the contributions on this subject is Hopkins's Bioclimatic law[1] which fixes the comparative time of occurrence of any periodic development in life in terms of altitude, longitude and latitude. Before this time, however, Doctor Merriam of the Biological Survey formulated a law of plant and animal distribution in terms of temperature alone. According to this law, the northward distribution of species is governed by the sum of the develop-

[1]Mo. Weather Rev., Suppl. 9, 1918.

mental temperatures occurring during the growing or reproductive season, while the southward distribution is limited by the mean temperature of a short period during the hottest part of the year. Sanderson modified Merriam's findings by including minimum winter temperatures as an additional factor in limiting northward distribution. From the economic standpoint, Sanderson's conclusion is of primary importance, since winter killing has a definite relation to the destructive abundance of insects.

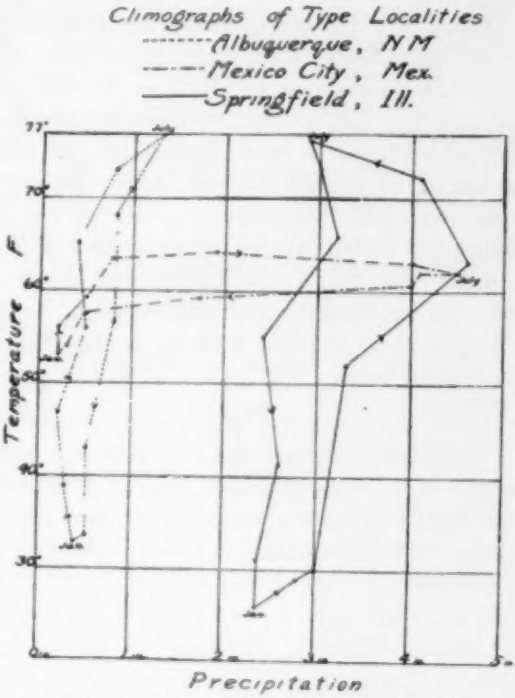

Fig. 1.—Climographs of Type Localities

Other investigators have pointed out the relation of climatic conditions to insect outbreaks, but in most of these cases only one factor of climate was considered and this attained its importance by its deviation from the normal. Such unusual occurrences, while influencing seasonal abundance, would probably have no intimate relation to the permanent economic distribution of insects. The difficulty of correlating climatic factors to animal behavior has been pointed out by Hopkins in the following quotation: "Notwithstanding the recognized importance of temperature as a means of interpreting the influences which control the life activities of plants and animals, it has been recognized by many investigators, and especially those engaged in the study of periodical phenomena of species and varieties, that temperature is only one of the elements which characterize the climate of a place, region or continent. Therefore, the influences which control periodical life activities are not to be found in one element alone, but in the fundamental forces and the complex of elements and factors as a whole. The quite early recognition of this fact has led to the consideration and investi-

gation of the solar influence through diffused light and sunshine and to that of rain, snow, humidity, wind and other phenomena and elements of the atmosphere; also the modification of the influences of these elements under the varying conditions of latitude, longitude and altitude, * * * * *."

While the foregoing quotation mentions numerous factors which would be difficult to correlate, it has been learned from many examples that the climatic factors of temperature and humidity have an important limiting influence on the distribution of many insects. Temperature plays the more important rôle in limiting the economic distribution of insects like the harlequin cabbage bug and several root maggots, while humidity is probably the determining factor in outlining the distribution of insects like the chinch bug, sugar-beet leafhopper, the stalk borer, melon and pickle worms, etc. Some of the effect of temperature and humidity may be due to their influence on the occurrence of suitable food plants but there is also reason to believe that these factors also have a direct influence on the insects themselves.

The Mexican Bean Beetle

The Mexican bean beetle is believed to be a native of the plateau region of Southern Mexico. In this area it has been reported only from the higher altitudes, above 4,000 feet, and therefore, from Merriam's chart, may be considered an Upper Austral or Transition form. In the southwestern part of the United States, where it has been known to occur for at least 75 years, it is again found in the Upper Austral and Transition zones at altitudes varying from 3,500 to 7,500 feet. The present distribution of the insect in the East is largely limited to the humid sections of the Upper Austral and Transition zones, though there is a considerable area in the southern part of the infested territory which is within the Lower Austral Zone.

An attempt to foretell the possibilities of the Mexican bean beetle in the East meets with some difficulty, since it is impossible to consider such little known factors as variable barometric pressures resulting from different altitudes, the effect of different methods of bean culture, etc. It is possible, however, to compare such climatic conditions as temperature and humidity with those occurring where the insect has long been present. These climatic comparisons may be made by utilizing climographs after the general method devised by Ball.[2] Owing to inability to obtain comparable humidity readings, the mean precipitation has been plotted against mean temperatures. In the charts the

[2]Cairo Sci. Jour., Vol. 4, No. 50, 1910.

abscissae measure the mean precipitation in inches per month, while the ordinates show mean monthly temperatures. In practically every case the figures are averages taken from long time observations.

An examination of the climograph for Mexico City (Fig. 1) shows small temperature and large rainfall variations, while in the climograph for Albuquerque exactly the reverse is true. The temperatures in Albuquerque are slightly higher in summer and considerably lower in winter, and the rainfall is low throughout the year, the maximum occurring during midsummer. In the case of Mexico City, the rainfall variation is large, the maximum also occurring during midsummer. While the two climographs are quite dissimilar, they agree in one point at least, the winter is dry. The Springfield climograph shows that the Eastern United States represents an entirely different climatic type.

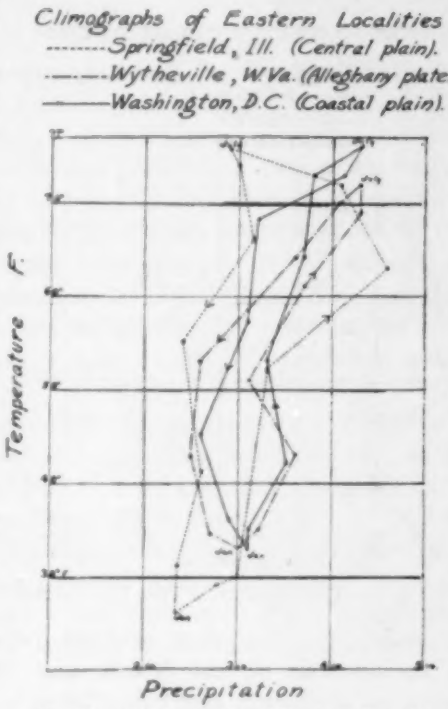

Fig. 2.—Climographs of Eastern Localties

Since the Mexican bean beetle has shown an ability to be a serious and consistent pest in the Mexican and western areas which show a wide variation in the two important climatic factors of temperature and rainfall, it may be assumed that this insect does not belong to the group which is readily influenced by different climatic conditions.

Climographs for localities east of the Mississippi do not show any important variation. While maximum and minimum temperatures may vary with latitude and altitude, the yearly spread is in the neighborhood of 40 degrees F., with the precipitation quite evenly divided. The general similarity of climate for eastern localities may be shown by plotting the climographs of Springfield, Ill., Wytheville, W. Va., and Washington, D. C., which may be considered as fair representatives of

Central Plain (Fig. 2), Mountain, and Coastal Plain areas. The small variations shown in these charts are hardly important enough in themselves to influence the development of insects not readily susceptible to climatic changes.

In order to compare climate by areas rather than by localities, composite climographs were plotted from average monthly means of temperature and precipitation for the Eastern, Western and Mexican districts (Fig. 3). Mexico City and Cuernavaca were selected as representative of climatic conditions in the infested area of Mexico. The localities selected for the western composite include Mesilla Park, Mountainair and Albuquerque, N. M., and Fort Collins, Colo. For the Eastern Composite 16 cities were selected between Burlington, Cleveland and Indianapolis on the North and Nashville, Birmingham and Atlanta on the South, care being taken to include representative areas from the Central Plain, Mountain and Coastal Plain areas. In comparing these composites, it is seen that all agree with respect to mean temperatures during the summer months when the insect is reproducing. There is a wide variation in summer rainfall but it is noted that the eastern composite lies about midway between those for Mexico and the West, thus indicating that summer precipitation in the East would of itself not be unfavorable to the development of the insect. Winter conditions, on the other hand, show a considerable variation both as regards temperature and precipitation. Mean winter temperatures for the eastern and western areas agree quite closely, both being considerably lower than the average winter mean for the Mexican area.

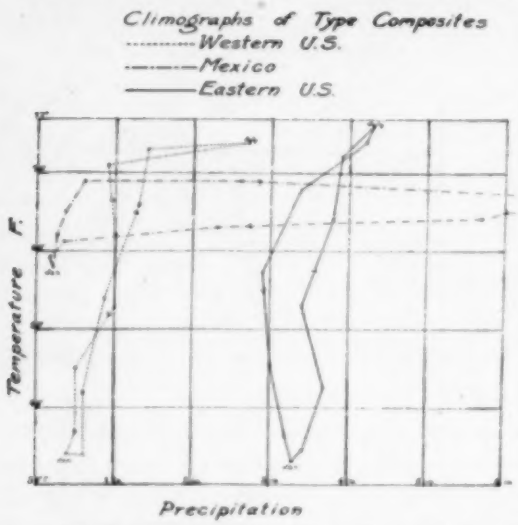

Fig. 3.—Climographs of Type Composites

The outstanding variation in the composite climographs deals with winter precipitation. In the case of Western and Mexican stations, the average mean precipitation during winter is less than one inch to the

month, while for the eastern stations a similar average lies between 3 and 4 inches. This in itself might seem to prove an important check to the insect, but before drawing hasty conclusions, it must be borne in mind that weather records in the West are taken in the dry, windswept valleys, whereas the beetles hibernate in the snow-filled canyons. The precipitation is not only much greater in the mountains but the leaf accumulations in which the beetles hibernate hold moisture over long periods. During April, 1922, beetles taken from moist situations in the mountains were covered with minute droplets of water at a time when frequent dust storms swept the adjacent valleys. Small collections of hibernating beetles taken during this period indicated that the highest winter mortality may be expected in colonies hibernating in dry situations. Observations on hibernation in the East at Birmingham, Ala., and Chattanooga, Tenn., have shown that winter survival under conditions of heavy precipitation is sufficient to insure a general infestation of bean fields during early spring.

A comparison of the climatic factors of temperature and precipitation in areas long infested by the bean beetle with representative localities in the East does not therefore lead to any hope that the insect will be greatly checked by climatic conditions which normally may be expected in this area. It may be possible that certain other factors, such as the absence of suitable hibernation quarters in flat, intensively cultivated areas will serve to keep the bean beetle from attaining injurious abundance, but only observation over a period of years will disclose the answer to this question.

PRESIDENT A. F. BURGESS: Inasmuch as there is another paper dealing with this same insect, we will defer discussion and I will call for that at this time. It is by Neale F. Howard.

RECENT DEVELOPMENTS OF MEXICAN BEAN BEETLE INVESTIGATIONS

By NEALE F. HOWARD, *Birmingham, Ala.*

(Withdrawn for publication elsewhere)

PRESIDENT A. F. BURGESS: We will now have a discussion on the two papers dealing with the Mexican bean beetle.

MR. E. P. FELT: Can you give any explanation for the fact that the beetle does not spread further south?

MR. N. F. HOWARD: No sir, except that it is a more northern form, from higher altitudes in the Southwest and Mexico and may be better

adapted to the northern United States than the extreme southern United States.

MR. J. J. DAVIS: What cultural methods do you recommend?

MR. N. F. HOWARD: Practices which promote the early maturity of the crop; plowing under destroyed fields to cover beetles and immature forms present; plowing under remnants of crop immediately after last picking in the case of green beans.

MR. G. W. HERRICK: Have you learned how many generations there are in Ohio?

MR. N. F. HOWARD: One generation with a partial second occurred at Columbus, where Dr. DeLong and Mr. Potts carried on the investigations for the Bureau in 1924. The first eggs of the earliest females of the first generation developed to maturity.

PRESIDENT A. F. BURGESS: The next paper is by S. Marcovitch.

NON-ARSENICALS FOR CHEWING INSECTS

By S. MARCOVITCH, *Agricultural Experiment Station, Knoxville, Tennessee*

ABSTRACT

Sodium fluosilicate with nine parts of hydrated lime, by volume, gave good control in field trials against the Mexican bean beetle. Sodium fluosilicate undiluted was effective in cage tests against the cotton boll weevil. .01 per cent of mustard gas (dichlorethysulfide) with a little ether adsorbed on charcoal was used successfully against the Mexican bean beetle under cages.

In the tests conducted with numerous non-arsenicals against the Mexican bean beetle (*Epilachna corrupta*) and the cotton boll weevil (*Anthonomus grandis*), a special study was made of the fluorine compounds since the efficiency of sodium fluoride for roaches and chicken lice is well known. As sodium fluoride is soluble, it is very injurious to plant life. The less soluble fluosilicates of sodium and calcium, as well as the mineral cryolite were found to be highly effective. Mustard gas adsorbed on charcoal also gave good results against the adult beetles. With these materials it is not necessary for the beetles to eat bean foliage in order to be killed, as is the case with the arsenicals. It is necessary only that they walk over plants dusted with either sodium fluosilicate or charcoal impregnated with mustard gas, so that some of the dry powder will cling to the legs and body. These materials induce an irritation which causes the beetles to lick their feet. Thus the poison enters the mouth and death results within a few hours. When properly used, these chemicals are not injurious to bean foliage.

Cage Experiments

Sodium Fluosilicate

Control of other insects. Experiments were conducted with sodium fluosilicate against cockroaches and poultry lice, for which sodium fluoride is commonly recommended. It was found effective against roaches and superior to sodium fluoride for poultry lice. Mr. Zuger, of the poultry department of the University, who conducted most of the tests, observed that after an application of sodium fluosilicate chickens remained free of lice for a much longer period than when dusted with sodium fluoride. He also found that the wing louse (*Lipeurus variabilis*) was more effectively controlled by sodium fluosilicate.

Tests conducted against the potato beetle (*Leptinotarsa decemlineata*), the potato flea-beetle (*Epitrix cucumeris*), the bean leaf-beetle (*Ceratoma trifurcata*), the cucumber beetle (*Diabrotica vittata*), and the tobacco horn-worm (*Protoparce quinquemaculata*) showed that they could be readily killed with sodium fluosilicate when one part was mixed with 9 volumes of lime. When undiluted with lime it caused some injury to the plants, particularly in the case of tobacco.

Since sodium fluosilicate is both a contact and a stomach poison, it should theoretically be effective against the boll weevil (*Anthonomus grandis*), and such was found to be the case. Cotton is a comparatively resistant plant, and is not injured when sodium fluosilicate is used undiluted. In all the tests conducted, the weevils were killed in from 5 to 24 hours. Calcium arsenate under similar conditions required from 1 to 5 days to kill the weevils. It was also observed that they could be killed in the same length of time by contact alone. To make sure that they were killed by contact, some weevils were placed on a bean plant, which they do not eat. After crawling over the bean plant, which had been dusted with sodium fluosilicate, 50 per cent of the weevils were dead in 6 hours, and the rest were found dead the next morning.

Advantages over the arsenicals. Sodium fluosilicate is superior to the arsenicals in several different ways. In the first place, it is cheaper. The wholesale price is 4 cents per pound at the present time, while calcium arsenate is quoted at 9 cents per pound, and magnesium arsenate at 25 cents per pound.

Secondly, sodium fluosilicate is both a contact and a stomach poison and acts more rapidly than the arsenicals.

Shafer, in his classical work "How Contact Insecticides Kill,"[1] has

[1]Mich. Agr. Exp. Station Tech. Bull. No. 21.

shown how sodium fluoride is effective against roaches. In much the same way sodium fluosilicate is effective against the bean beetles.

Thirdly, it is considered less dangerous to man. This is a distinct advantage, for in spite of the improbability of human poisoning from beans which have been dusted with calcium arsenate, the prejudice is so great that many farmers refrain from applying arsenicals to beans. On the other hand, sodium fluosilicate in small quantities is non-poisonous to man, and for that reason should be more popular than the arsenates for dusting beans. It should not be taken for granted, however, there is no danger whatever and the material used carelessly. Recently there was reported a fatal case of poisoning[2] by the eating of bread, the flour of which was accidentally mixed with sodium fluosilicate.

Another advantage of sodium fluosilicate is its efficiency against widely separated insects such as chicken lice, cockroaches, and potato beetles.

Disadvantages. As obtained on the market to-day, sodium fluosilicate is two or three times as heavy as calcium arsenate. A pound of the latter will occupy 80 cubic inches, and will cover a larger surface than sodium fluosilicate. In the manufacture of calcium arsenate, however, considerable experimental work was necessary in order to obtain a light, fluffy, material. A few preliminary experiments showed that concentrated solutions of sodium chloride or sodium bisulphate when added to hydrofluosilic acid gives a light precipitate. Sodium silicate added to hydrofluoric acid also gave a "light" precipitate which showed properties analogous to sodium fluosilicate. It is probable that further research will solve this factor of density, and that a lighter sodium fluosilicate can be obtained.

Sodium fluosilicate cannot be used as a liquid spray on beans because it is more or less injurious to the tender bean foliage. Used as dust and mixed with hydrated lime, no injury is apparent.

Source and uses. Sodium fluosilicate occurs as a by-product in the manufacture of acid phosphate. When phosphate rock and sulphuric acid are mixed, hydrofluosilicic acid is liberated. Upon the addition of sodium chloride or sodium bisulphate, sodium fluosilicate is precipitated. Sodium bisulphate or nitre cake is a by-product in the manufacture of nitric acid. It is therefore entirely possible to manufacture sodium fluosilicate from by-product chemicals for which there is little use at the present time. Sodium fluosilicate is used in the ceramic industries and in enamel factories for the manufacture of glass and tile. It is also used

[2]Bull. Sci. Pharmacol. Vol. 30:211. 1923.

as an antiseptic and germicide, and is considered superior to either the fluorides or corrosive sublimate in certain medical practices. It is soluble to the extent of 1 part to 200 parts of water.

Calcium Fluosilicate

Good results having been obtained with sodium fluosilicate, other fluorine compounds, such as calcium fluosilicate ($CaSiF_6$), were tested. This material is not at the present time produced in large quantities, so that an excessive price has to be paid for a small amount to be used experimentally. The pure calcium fluosilicate was found extremely toxic to the bean beetles, requiring but a few hours to kill them; but the plants were severely injured.

An attempt was made to make a small amount in the laboratory by adding an excess of milk of lime to hydrofluosilicic acid. The precipitate obtained did not injure the plant and did not kill as rapidly as the pure calcium fluosilicate, due possibly to the formation of inactive substances such as calcium fluoride. When ground calcium carbonate was substituted for the lime, the resulting product showed practically as much killing power as the pure calcium fluosilicate with but slight injury to the plant. Further research is needed to determine the action of the oxides and carbonates of calcium with hydrofluosilicic acid.

Cryolite

Samples of the powdered native mineral ($Al_2F_6.6NaF$) were obtained and dusted on bean plants under cages. It was found very efficient, killing bean beetles in from 10 to 20 hours. It very likely breaks up when ingested by the insects and forms toxic products. Fluospar, on the other hand, is much more stable and therefore much less toxic.

Mixed with 5 parts of hydrated lime, cryolite killed the beetles but also injured the bean plant. It was very evident that cryolite reacts with hydrated lime, even when used as a dust. The chemistry of cryolite-lime mixtures will not be taken up at this time, but it is certain that various toxic fluorides, aluminates and hydroxides are formed. When cryolite was mixed with two parts of lime, the beetles were dead after 2 days, and the plant was not injured. A spray containing 2 pounds of cryolite and 4 pounds of lime per 50 gallons of water was found effective in killing the beetles within two days.

Silica By-product

As mentioned previously, hydrofluosilicic acid is a by-product from the manufacture of acid phosphate. Formerly the by-product gases were allowed to pass into the atmosphere. Since even a very small

percentage of fluorine gas in the air is highly injurious to plant life, many complaints were made by growers in the neighborhood of fertilizer factories. To overcome this difficulty, the gases are now passed into towers with dripping water, forming hydrofluosilicic acid and a precipitate of silica. A sample of such by-product silica gave fair results in killing adults of the Mexican bean beetle. It is obvious, since pure silica is not an insecticide, that some impurities, such as adsorbed fluorine compounds, are the active insecticidal ingredients. One other sample of silica, obtained from an entirely different source, also showed some insecticidal properties.

Adsorbed Gases

The value of an insecticide is determined to a large extent by its physical state, it being most efficient in the form of a gas. The gases used in the late war have been tried out as poisons in various ways by many investigators,[3] with satisfactory results for stored-product and other insects. In the field, however, marked injury to the plants takes place when gases are used as in fumigating.

To obviate injury to the leaves, the writer conceived the idea of using charcoal impregnated with adsorbed gases which would be liberated gradually. Thus not enough gas would be present to injure the plant, while it would kill those insects which crawled over the material.

The results were gratifying, indeed, particularly with respect to the Mexican bean beetle. Mr. C. W. Exton, of the Chemical Warfare Service, supplied samples of activated and unactivated charcoal with various percentages of mustard gas, dichlorethysulfide $(ClCH_2CH_2)_2S$. This compound is a colorless, oily liquid, with a boiling point of 215°-217°C. Of all the war gases, it is one of the most toxic. It should be used with caution, since it has an irritating effect on the skin, upon prolonged exposure, in as low a concentration as 1 to 5,000,000. Amounts as small as .01 per cent of mustard gas on charcoal with a little ether proved effective in killing bean beetles in from 3 to 6 hours.

With other insects, impregnated charcoal gave varying results. Small tobacco hornworms were killed by .01 per cent mustard gas, but the large ones were not affected.

No field trials were made with the mustard gas, but one plot was dusted with wood charcoal which had been mixed with about 5 per cent liquid nitrobenzene. Good control was obtained by four weekly applications. Examination among the plants also revealed dead beetles.

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[3]McDonnell, C. C. Recent progress in insecticides and fungicides. Industrial and Engineering Chemistry, 16: 1018. 1924.

Adsorbed gases were also tried against the boll weevil. In general, the results were the same as those secured against the bean beetle, but less effective control was obtained. The smaller percentages of mustard gas, such as .01 per cent, gave better control than the larger percentages, probably because the small amounts also contained ether. In many cases weevils succumbed in 4 hours after crawling over charcoal impregnated with .01 per cent mustard gas and a little ether.

Discussion as to the Peactical Control of the Mexican Bean Beetle

One reason why many gardeners fail to keep the Mexican bean beetle in check is that the familiar principles of control for the potato beetle are applied to the bean beetle. The rule followed in the control of the potato beetle is to apply an arsenical when the grubs are conspicuous. Since the young of the potato beetle eat the entire leaf, it is very easy to poison them. With the bean beetle, however, feeding takes place almost altogether on the underside of the leaf, so that poison applied in the ordinary manner fails to kill them. Furthermore, when the spray or dust is applied to the underside of the leaves, it is difficult to coat them evenly and thoroughly, and many of the larvae escape.

In our experiments it was found to be much easier to drive away or to kill the active adult beetles than to kill the larvae, particularly when sodium fluosilicate was used as a dust. It was observed that the beetles are very sensitive to any dust on the plants, such as lime or wood ashes, and one can literally "scare" them out of a patch when it is kept thoroughly covered with such materials. For this reason, much better success can be had if control measures are directed against the adult beetles when they first make their appearance. The remark is sometimes heard that the bean beetle is not as bad as it was two or three years ago. Investigation usually shows that some material such as wood ashes, lime, or road dust is being applied. As the cost of sodium fluosilicate is comparatively small, much better control may be had by mixing it with hydrated lime.

Summary

1. Experimental work has shown that many of the fluorine compounds are effective in destroying the adult Mexican bean beetles in Tennessee. Sodium fluosilicate, calcium fluosilicate, and cryolite have considerable insecticidal value when mixed with hydrated lime in the proper proportions.

2. Sodium fluosilicate is a contact as well as a stomach poison. Be-

cause of its irritating effect, the beetle attempts to clean its feet in its mouth. Enough of the chemical thus enters the mouth to cause death.

3. The advantages of sodium fluosilicate over the arsenicals are (1) that it is cheaper, (2) that it acts as a contact as well as a stomach poison, (3) that it kills more rapidly, (4) that it is less poisonous to people and (5) that it is effective against a variety of insects, such as chicken lice, roaches, tobacco hornworms, flea-beetles, and potato beetles.

4. The density of sodium fluosilicate, as obtained in the market today, is high, but work is being carried out to remedy this deficiency.

5. Cotton boll weevils were killed with sodium fluosilicate without lime in from 4 to 30 hours.

6. Gases adsorbed on charcoal gave good results as insecticides. Charcoal containing .01 per cent mustard gas with a little ether was dusted on plants, and bean beetles were killed in from 3 to 12 hours. Nitrobenzene on charcoal was also effective in destroying the beetles.

7. The above gases killed boll weevils in from 6 hours to 5 days.

8. When used as a dust, sodium fluosilicate mixed with 9 parts, by volume, of hydrated lime gave excellent control in the field against the bean beetle.

9. When mixed with 9 parts of hydrated lime, and properly used, sodium fluosilicate showed a net return as high as $187.60 per acre, at a time of the season when the bean beetles were very abundant.

MR. S. B. FRACKER: I would like to inquire whether sodium fluosilicate is now being commercially manufactured, and if so, where.

MR. S. MARCOVITCH: It is produced in large amounts as a by-product from the manufacture of acid phosphate. It can be obtained from any of the phosphate companies, like the Virginia-Carolina Chemical Company, and several others.

PRESIDENT A. F. BURGESS: The next paper is by H. C. Huckett.

THE CONTROL OF APHIDS[1], WHICH INFEST CAULIFLOWER SEED BEDS ON LONG ISLAND, BY MEANS OF TOBACCO DUST MIXTURES

By H. C. HUCKETT. *Riverhead, Long Island, N. Y.*

ABSTRACT

Of late years the cauliflower growing industry on Long Island has been seriously endangered owing to lack of healthy plants in the seed bed. This condition is largely due to injury caused by aphids, *Myzus persicae* Sulz. and *Macrosiphum solanifolii* Ashm., which migrate from the vast areas of potatoes onto the seedlings. There the migrants breed rapidly under favourable weather conditions.

[1] *Myzus persicae* Sulz., *Macrosiphum solanifolii* Ashm.

Several insecticides have given satisfactory results in killing the aphids, notably nicotine sulphate solutions, soap solutions, nicotine sulphate dusts, but each method has under practical conditions failed to give satisfactory control. The chief reasons for this failure are faulty means of application and excessive number of applications that are required to meet incessant infestation, which entails excessive labor costs.

Tobacco dust-hydrated lime mixtures have shown effective killing properties and have given efficient control when applied to the seedlings. The advantages of this method of treatment are, (1) cheapness and simplicity of application, namely by hands, (2) the limited number of applications necessary (weather permitting), namely two or three. The disadvantage to the method is the necessity for heavy applications of the mixture, which entails a higher cost of material than in the case of nicotine sulphate sprays or dusts.

Tobacco dust mixed with hydrated lime in equal proportions by weight has resulted in as efficient control as less diluted mixtures. The tobacco dust as used in the experiments was of 200 mesh fineness and of 1% nicotine content.

Cauliflower growing is one of the most important farming industries on Long Island. Much depends each year on the health and vigour of the seedlings for the successful production of the crop.

Among the most dangerous pests of the seed bed are aphids. It so frequently happens that at the time when aphids commence to migrate from potatoes that cauliflower plants are in the seedling stage, and the seed bed thus serves as an excellent camping ground for the winged migrants and their progeny. The species which causes most injury is the spinach aphis, *Myzus persicae* Sulz. This species overwinters on Long Island in the egg and nymphal stages on cruciferous crops that are capable of surviving the winter. In the Spring and early Summer most winged forms migrate from their temporary host plants to the vast areas of potatoes, where the aphids breed and multiply until potatoes commence to blossom. With the disappearance of the blossoms there commences a general exodus of the winged migrants from the potato to any other form of vegetation. Nearly all vegetables and weeds, at this season of the year, become plastered, to a greater or less extent, with aphids, the cauliflower seed bed receiving its due share. The effect of feeding injury by aphids on seedlings under weather conditions that favour aphid multiplication and that do not favour plant growth is such, that if the plants are less than half grown, they will be seriously stunted, if not entirely killed. Plants that are more than half grown when infestation occurs are retarded and stunted in growth, making inferior plants for transplanting to the field. Under weather conditions that favour plant growth, seedlings do not show the effect of aphid feeding to a marked degree, especially if the plants are more than half grown. Wet weather will almost entirely eliminate the injurious effects of aphids.

Control Measures

The commonest means employed by farmers to check the amount of injury by aphids is a spray mixture of nicotine sulphate, 1 pint, to 100 gallons of water. This solution is commonly applied by means of a barrel pump, mounted on a light wagon, with one or two leads of hose, 30–50 feet in length, attached to the ends of which are short extension rods with one or two angle nozzles.

This is a satisfactory method of treating the seed bed provided the applications are timed to meet the needs of the situation. When aphids are particularly abundant and harmful the applications should be made at intervals of three or four days for a period of two weeks.

The chief advantage of this method is the low cost of the spray mixture: the chief disadvantages are the temporary effectiveness of the spray in protecting the plants from reinfestation, and the cost in time and labor in making the applications.

More recently two per cent nicotine sulphate dusts, applied by means of a crank type of hand duster, have been used to control aphids in the seed bed. Such dusts, when applied under favourable weather conditions and in generous quantities, have been effective in killing aphids, but as, with nicotine sulphate sprays, the average farmer becomes weary in well doing and fails to apply the dust frequently enough when most needed.

The chief advantage of this method appears to be the ease and rapid manner wherewith dust mixtures may be applied; the chief disadvantage is the temporary effectiveness of nicotine sulphate dusts in protecting plants from reinfestation.

In 1923 comparative tests were made with pure tobacco dust, of superfine quality and containing one per cent nicotine; together with two per cent nicotine sulphate-hydrated lime dust mixture; and a nicotine sulphate spray composed of one pint of Black Leaf 40 and 100 gallons of water.

These tests with tobacco dust mixtures were made with the object of trying to find a nicotine product which would be more lasting in its effectiveness in protecting the plants from repeated reinfestation than nicotine sulphate sprays and dusts.

The seedlings used for the experiment appeared above ground on July 10 and were seriously infested with aphids in three and four days. The applications of the insecticides were made on July 19, July 24 and August 9; temperatures on these occasions registered 81°F., 79°F., 82°F., respectively. The tobacco dust was applied by hand at the average rate

of ½ lb. per 15 yards; the nicotine sulphate dust by a hand duster at the average rate of five ounces per 15 yards; the nicotine sulphate spray by a hand sprayer at the average rate of one and a half gallons per 15 yards. The results were recorded on August 23 as shown in Table 1.

TABLE I —TO SHOW THE RESULTS OF DUSTING AND SPRAYING IN THE CAULIFLOWER SEED BED AGAINST APHIDS

Plot	Treatment		Nos. of applications	Total nos of plants	Number of plants. Grades 1	2	Culls	Per cent of Grade 1 plants
2	B. L. 40	5 lb.						
	Hydr. lime	95 lb.	3	313	133	76	104	42.49
3	Tobacco dust (superfine)		3	361	239	49	73	66.2
			2	106	67	30	9	63.21
4	B. L. 40	1 pint						
	Water	100 gals.	3	223	87	44	92	39.01
5	Check			70	12	13	45	17.14

According to Table 1 it will be seen that rows treated with pure tobacco dust yielded approximately 25% more first class plants than rows treated with nicotine sulphate dusts and sprays, and approximately 48% superiority in this respect than check rows.

During the winter of 1923–24, experiments were carried on under greenhouse conditions with superfine tobacco dust diluted with hydrated lime in the proportions of 90:10, 85:15, 75:25, 50:50, by weight respectively, for the purpose of cheapening the dust mixture without losing its aphiscidal properties.

The method employed was essentially as follows:—lantern chimneys, that were covered with cheesecloth, were dusted with the respective dusts until the sides were covered with dust particles. Each chimney was then placed over a seedling leaf infested with aphids (*M. persicae*) for two to six hours. The leaves were held in position by a vial containing water and plugged with cotton wool. During the experiments temperatures in the greenhouse varied from 60° to 78°F.; humidity from 60 to 73%.

In the course of seven series of experiments the mixture which averaged the highest aphiscidal qualities was tobacco dust, 85 lbs., hydrated lime, 15 lbs. It was also found that dust mixtures which were exposed to greenhouse conditions for two days had lost but little of their killing efficiency; after exposure of five and nine days, mixtures such as 90:10, 85:15, still retained aphiscidal qualities, whilst mixtures such as 75:25, 50:50, lost to a considerable degree their toxic effect. Excessive moisture almost entirely destroyed the killing efficiency of tobacco dust mixtures.

In 1924, further tests were made in the seed bed with superfine tobacco dust-hydrated lime mixtures, the proportions used being 85:15, and 50:50, respectively, besides pure tobacco dust itself.

The seedlings used for the experiments appeared above ground on July 12, and were seriously infested with aphids in three and four days. The applications of the dusts were made by hand on July 19 and July 24 at the average rate of ten ounces per ten yards of the row; temperatures on these occasions averaged 80°F., and 78°F., respectively. The results were recorded on August 9, as shown in Table 2.

TABLE 2.—TO SHOW THE RESULTS OF DUSTING CAULIFLOWER SEED BED WITH TOBACCO DUST MIXTURES AGAINST APHIDS

Plot	Treatment	Nos. of applications	Total nos. of plants	Number of plants. Grades			Percent of Plants
				1	2	Culls	Grade 1 and 2
1	Tobacco dust (pure)	2	843	306	377	160	81.00
2	Tobacco dust 85 lb. Hydr. lime 15 lb.	2	553	225	267	61	88.97
3	Tobacco dust 50 lb. Hydr. lime 50 lb.	2	412	163	175	74	82.04
4	Check		0	0	0	0	00.00

According to Table 2, it will be seen that there was only a slight difference in results between the rows treated with tobacco dust. Seedlings treated with a mixture composed of 85 lbs. of superfine tobacco dust and 15 lbs. hydrated lime were slightly superior to the seedlings treated otherwise. The seedlings in the check rows were entirely killed, partly by the injuries from aphids and partly through the prolonged period of hot weather.

The chief advantages to be gained from the use of tobacco dust-hydrated lime mixtures appear to be, (1) fewness of applications, two or three are sufficient to obtain effective protection for the seedlings, (2) simplicity in application, i. e., spread along the rows by hand so as to smear the leaves. The chief disadvantage is the amount of dust used during treatment, which makes the applications expensive.

In conclusion, it may be said that tobacco dust of superfine quality mixed with hydrated lime, in proportions as dilute as equal parts by weight, has produced results which demonstrate its effective use as an insecticide against aphids in cauliflower seed beds. This effectiveness is partly due to the fumigatory conditions brought about by the heavy rate of application and due to the size of the seedlings treated. Seedlings less than half grown are more effectively treated than seedlings nearly full grown.

PRESIDENT A. F. BURGESS: The next paper is by R. E. Campbell.

THE PROBLEM OF CELERY LEAF-TYER CONTROL

By R. E. CAMPBELL, *U. S. Bureau of Entomology, Alhambra, Calif.*

ABSTRACT

The celery leaf-tyer (*Phlyctaenia rubigalis* Hubn.) was first reported as a serious pest in 1909 and caused such heavy losses in southern California that much of the acreage was abandoned. The leaf-tyer is most numerous and active, and develops more rapidly in the warm weather of the summer and fall. This is at the time when the main celery crop is young and growing vigorously. Lead arsenate, applied at the rate of 3 pounds to 100 gallons of water or Bordeaux mixture, and not more than 100 gallons of spray to an acre, gave satisfactory control. Several applications may be necessary at intervals of two weeks or more. These applications, being made on young, growing celery, are not likely to leave a residue of poison on the plants at harvest time. There is a considerable acreage of early celery, practically mature when the leaf-tyer is most abundant and is thus subject to heavy infestation. The protection of this celery in such a way that no poison remains on the plant at harvest time is a difficult problem. A close watch must be kept for the first infestations when the celery should be carefully sprayed, using adequate machinery, applying a fine misty spray to both sides of the leaves. The early applications are the most important, as they serve to reduce damage from later generations. All spraying must cease at least a month prior to harvesting.

The celery leaf-tyer (*Phlyctaenia rubigalis* Hubn.) was first reported as a pest in California in 1909, at which time extensive fields of celery in Orange County were severely injured. This injury, together with that caused by the blight (*Cercospora apii* F.), continued for several years, until finally a large proportion of the acreage in Orange County was abandoned. During the last few years that the growers produced celery in this section, they suffered such heavy losses that they still refuse, with few exceptions, even to attempt growing the crop again.

In southern California celery was mostly a fall and winter crop. The young plants for this crop were set in the fields in the latter part of July and early August, the earliest plantings reaching maturity in November. Harvesting began in November and continued into February. Most of the celery was shipped to Eastern markets in car lots.

The celery leaf-tyer is active throughout the year but during the cooler seasons requires longer periods to complete its life cycle as compared with the warmer months. In the summer the minimum life cycle requires 33 days and the maximum 53 days, the average being 42 days; in the fall the life cycle varies from 35 to 85 days, with an average of 55 days; in the winter the extremes are 90 and 145 days, and the average 113 days, while in the spring this period varies from 56 to 107 days and averages 79 days.

In the same locality with the celery fields are extensive plantings of sugar beets, which are the main source of infestation, as the insect develops on the beet foliage before the celery is planted. The beets are harvested in midsummer and the moths then migrate to the celery fields, and damage may result by the end of August, or in early September. Under favorable conditions, two, and even three, generations may develop before cold weather, but normally the first two generations cause the most damage, as the cooler weather of late fall or early winter retards the development of the third generation to such an extent that the damage is negligible. The generations in the field overlap and are indistinct, and during September and early October the fields are subject to continuous infestation from moths which have developed in the beet fields or in the early celery and seed beds. The problem of control on this early celery is confined to the insects on the young, growing plants, because the infestation may start early and the advent of cooler weather will so check the worms that they will do little damage in the late fall.

Spraying with lead arsenate at the rate of 3 pounds to 100 gallons of water will, when properly applied, give satisfactory control. Since the eggs are deposited on the under surface of the leaves and the young larvae feed there, it is necessary to cover thoroughly these portions of the plant with the spray. The best results are obtained by using either traction or power sprayers which maintain a pressure of 250 pounds. The disc nozzles should be arranged on a stationary boom, three to a row, the center one directed straight downward on top of the row and one on each side, carried near the ground, and directed toward the row and slightly upward. With a small disc opening a misty spray may be obtained which will permit the thorough covering of the plants by the use of not more than 100 gallons of the spray mixture per acre. Several applications may be necessary, as reinfestations may take place from the overlapping generations. It is not necessary, however, to spray more often than twice a month, and as the season advances the intervals between sprayings may be increased.

Owing to the early infestations and the necessity for controlling the first worms to appear, practically all the spraying is completed while the celery is young. With such treatment a considerable period will intervene between the last spraying and harvest. The rains occurring during this period will wash off some of the poison from the plants and much of the old outside growth, which was exposed to the spray, will die or be trimmed off at harvest. In addition, the new growth produced after spraying ceases is entirely clean. Hence there is little possibility that

the celery when marketed will carry a residue of poison that will endanger the health of the consumer. In order to be certain of entirely avoiding that danger, the grower should spray early and keep the infestation in check to avoid the necessity of late applications, all spraying ceasing well in advance of harvest time, and under no circumstances should more than 3 pounds of the arsenical to an acre be used for each application.

As the celery leaf-tyer attains its maximum abundance at a period when the early crop of celery nears maturity, and as control is more or less uncertain, owing to the difficulty of reaching the undersides of the plant, and, furthermore, as there is an element of danger to the consumer from the poison residue remaining on the celery, arsenical sprays at this late stage of development of the crop are not recommended. The large deposits of arsenic which remained on the celery in 1921 were, in part, due to lack of rainfall that season, but even in normal seasons when spraying is practiced shortly before harvest, sufficient arsenical residue is likely to remain on the celery to make the product unsafe. It is apparent, therefore, that the means of combating the leaf-tyer on the two crops, that is, early and late, must differ and that the control of the pest on the early crop is a difficult problem.

From experience with control of the celery leaf-tyer on both early and late celery, the following suggestions are made. The grower should acquaint himself with the moths, which hide in the foliage during the day and begin flying about sundown. They are easily disturbed by walking through the fields, and fly in a rapid, jerky manner, usually for only a short distance, alighting on near-by plants and immediately hiding among the leaves. When the presence of these moths is noted, a careful watch should be kept for the appearance of young worms. As soon as they are found feeding on the under sides of the leaves, an immediate application of spray should be made. A light misty spray should be thoroughly applied, care being taken that the under sides of the leaves are covered. Arsenate of lead should be used at the rate of 3 pounds per 100 gallons of water or Bordeaux mixture and not over 100 gallons should be applied per acre. The application should be repeated in from two to four weeks, and as often thereafter as necessary to prevent the development of any worms. It is especially important to prevent the development of the later generations on the early celery, as spraying must cease before the plants reach maturity, a month or more before harvest, depending on weather conditions. On account of the danger of an infestation after the celery is well grown, early celery should not be grown near a beet field.

PRESIDENT A. F. BURGESS: I would like to ask Mr. Campbell if any complaints have ever come from the Eastern markets on account of celery being heavily sprayed.

MR. R. E. CAMPBELL: All the complaints that we know of were from the Hospital and the Bureau of Chemistry, and the health authorities became very active when they discovered that, and Eastern shipment was prevented. I don't recall of any complaints from the East.

PRESIDENT A. F. BURGESS: The reason I asked that question was because of the fact that some time ago in conversation with the head chemist of the Bureau of Chemistry in Boston, he stated that celery had been received from Florida and that it had been sprayed very heavily with arsenate of lead. It was for the Navy Yard where they use the tops to make celery soup for the people who work there. On account of the heavy dosage of arsenate of lead on the celery tops a large shipment was condemned as being unfit for use. I don't suppose ordinarily the tops of celery are used.

MR. R. E. CAMPBELL: The inspectors refused to admit celery even though the analysis showed the material was entirely on the tops, because of the fact that in a few restaurants and in some other places the tops are used for soup and such purposes.

PRESIDENT A. F. BURGESS: These are California inspectors?

MR. R. E. CAMPBELL: Yes, and Bureau of Chemistry inspectors also. They analyzed the entire plant and they held it up if it showed traces of arsenate of lead.

The meeting adjourned at 5 p. m.

Morning Session, Friday, January 2, 1925

The session convened at 9:30 a. m., President Burgess presiding.

PRESIDENT A. F. BURGESS: The meeting will please come to order. The entomologists have been very successful in carrying on experiments of different sorts but up to the present time apparently they have not been able to control the weather. (Laughter.) In spite of the inclement weather and the difficulty of travel, I think we should feel very much pleased at the number who have been able to get here for the opening of the session this morning.

The next is a paper by C. A. Weigel.

FURTHER DATA ON THE USE OF CALCIUM CYANIDE AS A GREENHOUSE FUMIGANT

By C. A. WEIGEL, *Associate Entomologist, Fruit Insect Investigations, Bureau of Entomology, Washington, D. C.*

ABSTRACT

Comparative results of three series of fumigation tests in a box of 200 cubic feet capacity, using $Ca(CN)_2$ dust and granular $Ca(CN)_2$ at rates of ½ ounce per 1,000 cubic feet, and NaCN at the rate of ¼ ounce per 1,000 cubic feet with exposures lasting from 1 to 7 hours inclusive, and 15 hours, (or all night), on four species of aphids, namely, *Myzaphis* sp. on rose, *Aphis rumicis* on nasturtium, and *Macrosiphoniella sanborni* and *Rhopalosiphum rufomaculata* on chrysanthemum, are presented in the table. Overnight fumigation gave 100% mortality in each test.

Twenty-five large commercial greenhouses were fumigated recently using ¼ ounce of granular $Ca(CN)_2$ for each 1,000 cubic feet of space, all night and an excellent control of *Myzaphis* sp. with negligible burning on roses resulted. Other tests gave similar results with *Myzus persicae* on carnations, *Illinoia pisi* on sweet peas, and *M. sanborni* on chrysanthemums. A one-ounce dosage in orchid houses killed 100% Boisduval scale, *Diaspis boisduvalii*, and 52% of the chaff scale, *Parlatoria proteus* without injury to flowers.

$Ca(CN)_2$ is given off rather slowly and may require longer exposure than NaCN. It is however easier to use and, for that reason, may be more generally adopted by florists.

In an article entitled "Recent developments in greenhouse fumigations with hydrocyanic-acid gas" which was published in the April, 1924, issue of the JOURNAL OF ECONOMIC ENTOMOLOGY, the results of some preliminary experiments with calcium cyanide were presented. In that article it was pointed out that this material might very likely be adapted to greenhouse fumigation purposes.

During the current year experiments have been conducted for the purpose of securing answers to the two following questions: How soon after exposing calcium cyanide to the atmosphere of a fumigation box will the gas evolved therefrom reach a satisfactory killing concentration? Is it practical and effective to run overnight exposures at a concentration as low as ¼ ounce of calcium cyanide per 1,000 cubic feet of air space?

To determine the first question tests were made in a box of 200 cubic feet capacity, using calcium cyanide dust in one series, granular calcium cyanide in a second, and sodium cyanide, as a check, in the third. The lengths of exposures were 1, 2, 3, 4, 5, 6, 7, and 15 hours each, the last representing a full overnight exposure. Chrysanthemums infested with the black chrysanthemum aphid, *Macrosiphoniella sanborni* (Gill), and the green chrysanthemum aphid, *Rhopalosiphum rufomaculata* (Wils.), nasturtiums infested with *Aphis rumicis* Linn., and roses infested with *Myzaphis* sp., were used. The dosages employed in the first and second

series were ½ ounce of calcium cyanide in dust and granular forms respectively which is approximately equal to ¼ ounce of NaCN or the strength used in the third series. The calcium cyanide dust and the granular calcium cyanide used in these tests were applied by spreading them on newspapers placed on the floor of the box. In the sodium cyanide series the gas was generated by the usual "pot method," i. e., by adding the chemical to the required amount of water and acid.

It is evident from the results of these tests with calcium cyanide dust and sodium cyanide as presented in Table 1 that a satisfactory mortality was obtained only with *R. rufomaculata* in the one-hour exposure with both materials, the other species exhibited greater resistance. This checks well with the results usually obtained by the pot method. The granular calcium cyanide acts more slowly than either of the other materials. At the end of the second hour a higher and more consistent mortality resulted in almost all cases. Thereafter the effectiveness increased with the length of exposure, resulting in a 100 per cent mortality at the end of 15 hours or overnight exposure.

The practical significance of these results is that in very tight boxes or greenhouses or when it is not desirable to fumigate all night at this strength the houses may be aired at the end of two hours. For older houses which are often leaky the exposure may extend throughout the night since the leakage causes a decrease in concentration.

Practical Greenhouse Tests

In determining the practical value of fumigating commercial greenhouses overnight with calcium cyanide, preliminary tests were tried in greenhouses in Washington, D. C., with encouraging results. Later this phase of the work was transferred to the Willow Grove,[1] Pennsylvania, field station, in charge of Mr. C. F. Doucette, because of the close proximity of that station to many large rose and other floral greenhouses. During the last three months there were fumigated about 25 large houses, the plants of which were infested with species of aphids, primarily *Myzaphis* sp.

In these experiments the duration of the exposure was from 12 to 15 hours, usually beginning about 5.30 p. m. and ending the following morning not later than 7 o'clock. The size of the houses varied from 16,000 cubic feet to 266,800 cubic feet. A dosage of only ¼ ounce of the granular form of calcium cyanide is used for every 1,000 cubic feet. The

[1]This station is conducted in cooperation with the Bureau of Plant Industry, Pennsylvania Department of Agriculture, C. H. Hadley, Director.

TABLE I.—SHOWING RESULTS OF BOX FUMIGATION TESTS IN WHICH ½ OUNCE OF CALCIUM CYANIDE DUST, ½ OUNCE OF GRANULAR CALCIUM CYANIDE, AND ¼ OUNCE OF SODIUM CYANIDE, RESPECTIVELY, PER 1,000 CUBIC FEET OF AIR SPACE WERE USED

Fumigant	Exposure in hours	Temp.	Hum.	Rose[1] Myzaphis sp. No. of specimens	Rose[1] Myzaphis sp. Control	Nasturtium A. rumicis No. of specimens	Nasturtium A. rumicis Control	Chrysanthemum[2] M. sanborni No. of specimens	Chrysanthemum[2] M. sanborni Control	Chrysanthemum[2] R. rufomaculata No. of specimens	Chrysanthemum[2] R. rufomaculata Control
		°F.	Percent		Percent		Percent		Percent		Percent
$Ca(CN)_2$ Dust	1	69	76	163	56.4	90	18.8	676	62.2	278	82.7
Granular $Ca(CN)_2$	1	69	67	74	13.5	78	24.3	47	19.1	28	17.8
NaCN	1	67	71	115	61.7	55	18.1	677	52.1	255	81.1
$Ca(CN)_2$ Dust	2	74	47	287	81.1	326	83.1	421	92.8	36	100.
Granular $Ca(CN)_2$	2	67	66	93	61.2	29	55.1	313	85.9	127	92.9
NaCN	2	70	51	45	66.6	124	45.9	332	68.6	178	82.5
$Ca(CN)_2$ Dust	3	66	71	110	85.4	293	86.	424	98.3	139	99.2
Granular $Ca(CN)_2$	3	69	81	309	41.4	46	52.1	306	79.	174	85.
NaCN	3	64	60	29	93.1	38	86.8	398	81.4	85	100.
$Ca(CN)_2$ Dust	4	69	63	37	89.1	132	91.6	425	99.7	47	100.
Granular $Ca(CN)_2$	4	67	71	31	90.3	43	55.8	384	89.3	168	99.4
NaCN	4	70	55	37	83.7	71	81.6	187	85.	205	91.2
$Ca(CN)_2$ Dust	5	68	67	126	86.5	338	89.9	340	100.	99	100.
Granular $Ca(CN)_2$	5	64	65	117	86.3	111	75.6	205	89.2	156	95.5
NaCN	5	67	53	27	77.7	186	91.3	341	97.6	226	100.
$Ca(CN)_2$ Dust	6	67	80	42	100.	387	94.	299	99.6	25	100.
Granular $Ca(CN)_2$	6	62	64	55	80.	133	73.6	238	91.5	41	85.5
NaCN	6	65	66	47	89.3	52	96.1	418	100.	26	100.
$Ca(CN)_2$ Dust	7	64	79	225	96.4	181	99.4	339	100.	5	100.
Granular $Ca(CN)_2$	7	70	55	75	94.6	145	80.	150	100.	63	100.
NaCN	7	69	67	26	87.	101	97.	236	100.	124	100.
$Ca(CN)_2$ Dust	15	71	64	63	100.	100	100.	569	100.	28	100.
Granular $Ca(CN)_2$	15	63	69	121	100.	225	100.	391	100.	331	100.
NaCN	15	69	63	17	100.	113	100.	556	100.	396	100.

[1]Burning beginning with sixth hour.

[2]More or less burning throughout the series.

chemical was applied by sprinkling it evenly on the soil in either one or more walks or aisles, depending on the width of the house to be fumigated. The temperatures ranged from 59°F. to 73°F. and the per cent humidity was from 78 to 95.

The mortality in most of the tests was 100 per cent except in several instances where excessive leakage occurred due to broken glass, loose-fitting doors, or passageways which, under the existing conditions, could not be tightly closed. The outstanding features of these experiments were the excellent control and the negligible degree of burning from the gas on the roses.

In addition to these experiments, others were conducted in commercial houses where crops of carnations infested with *Myzus persicae* (Sulz.), sweet peas infested with *Illinoia pisi* (Kalt.), and chrysanthemums infested with *Macrosiphoniella sanborni* (Gill.), were fumigated with similar results. Large orchid houses, containing cattleyas, cypripediums, and other varieties, were fumigated at a *one*-ounce rate of dosage, resulting in a mortality of 100 per cent of the Boisduval scale, *Diaspis boisduvalii* Sign., and of 52 per cent of the chaff scale, *Parlatoria proteus* (Curtis). It is of interest to note here that in some cases the orchids were in flower and passed through the fumigation without injury.

A satisfactory control was obtained with the greenhouse white fly, *Trialeurodes vaporariorum* (Westw.), on snapdragons, marguerites marigolds, sweet peas, salvias, fuschias, and primulas, at the ¼ ounce dosage.

Conclusions: Fumigation with calcium cyanide in granular form, used in a low concentration, as ¼ ounce per 1,000 cubic feet of air space (approximately equal to ⅛ ounce of sodium cyanide), with an exposure lasting over night, appears to be an effective and practical method of controlling aphids and the adults of white flies that are ordinarily encountered on roses, chrysanthemums, carnations, and the other commercial crops mentioned in this article. Hardier plants, as palms and orchids, will apparently withstand without injury a much higher concentration.

It must be remembered, however, that if this dosage were increased and the same length of exposure employed, injury to the above mentioned crops would very likely occur. The longer exposure seems more desirable when using calcium cyanide than when using sodium cyanide and generating the gas by the pot method. With the latter it is generally the practice to use higher concentrations and shorter exposures, usually not longer than one hour, because the gas is assumed to be given off

within the first few minutes after the sodium cyanide is added to the acid and water; while in the case of calcium cyanide the evolution of the gas is apparently somewhat slower since it is dependent on the action of the atmospheric moisture.

From the foregoing results it would seem that calcium cyanide may be more generally adopted by florists for fumigating purposes. It is easier to use than sodium cyanide, since it does away with the cumbersome weighing and measuring necessary in fumigation by the pot method.

MR. G. M. BENTLEY: I would like to ask the cubical content.

MR. C. A. WEIGEL: The cubical content of the box in which the first tests were carried out was 200 feet, and after the box tests were completed the tests were run in commercial greenhouses with a varying capacity of from 18,000 cubic feet of space up to 300,000.

PRESIDENT A. F. BURGESS: The next paper is by Miss B. M. Broadbent.

NOTES ON THE LIFE HISTORY OF THE LESSER BULB FLY *EUMERUS STRIGATUS* FALLEN

By Miss B. M. BROADBENT, *Junior Entomologist, U. S. Bureau of Entomology*

ABSTRACT

The lesser bulb fly was reared from infested bulbs received from California and Washington. The pupal period varied from 8 to 16 days. Maximum longevity of flies was 23 days. Flies were fed on honey. Mating occurs in sunlight. Small white eggs were deposited in masses between layers of dry brown skin at neck of bulb, but not in decaying bulbs. Larvae in feeding rasp the bulb tissue with their mouth hooks. Later they feed in decaying or fermenting areas. Some larvae which hatched Auguse 26, pupated a month later and emerged during October. While the other larvae of the same generation have not pupated after more than three months. Larvae reared from the partial brood that emerged are now practically the same size as those of the previous generation.

The evidence is not yet conclusive, but it is probable that this species deserves recognition as a potential enemy of narcissus bulbs and onions.

The present investigation of the life history and behavior of the lesser bulb fly, *Eumerus strigatus* Fallen, was undertaken in order to determine the life cycle of this species under cage conditions in the greenhouse during the fall and winter months, and also to discover its probable status as an economic pest of narcissus and onion.

A shipment of narcissus bulbs heavily infested with larval and pupal stages was received on the 1st of August, 1924. Many flies emerged daily from then until September 4. Maximum emergence occurred at

night, although a few came out during the day. The duration of the pupal period varied from 8 to 16 days, with an average of 11.5 days based on 66 specimens.

The flies were confined in cages containing pans of narcissus bulbs and onions. At first many of the flies died within 4 days after emergence because of the extreme heat and the lack of suitable food for them. Later 10 flies that emerged August 26 lived 3 weeks, the maximum longevity being 23 days. Various feeding methods were tried unsuccessfully until it was discovered that the flies would lap up extracted honey smeared on the wire of their cages.

The first evidence of mating was observed August 18, and in some cases it began the day following emergence. Mating was observed to last from 2 to 15 minutes with an average of 6 minutes based on 20 pairs of flies. This activity is closely associated with sunlight, and can be induced by artificial light on cloudy or rainy days. In cloudy weather the flies are very sluggish, but when the sun shines they frequently hover in the air over the plants or fly about the cage.

The first eggs were found on August 21. They were small, white, and elliptical, and were deposited usually in masses between the outer layers of dry, brown skin of narcissus bulbs and onions. Occasional egg masses were found on the soil but in no case were they found in decaying portions of bulbs. As many as 40 eggs were found in a single mass between the soil and a small sprouted onion, and 53 eggs were in scattered masses under the outer skin of another bulb. The evidence indicates that the flies are capable of inserting the eggs between the outer layers of skin at the neck of the bulb for a distance of nearly an inch.

Flies emerged from September 17 to 30 from infested narcissus bulbs which were sent in from Bellingham, Washington. They behaved in the same manner as the flies from California and deposited their eggs in similar locations.

Eggs laid by flies which had emerged August 26 were hatching September 5. The exact period of incubation was not determined. Larvae that had hatched September 2 and were two weeks old were placed on a piece of onion between 2 glass slides with a ridge of paraffin around the edges. Under the microscope they were observed to thrust forward their mouth parts and scrape or rasp the surface of the tissue with their mouth hooks. The cephalopharyngeal skeleton is well developed.

The duration of the larval period appears to be very variable. Some larvae of this generation pupated about one month after hatching, while

others have not pupated after a larval stage which has already lasted more than three months.

Flies of the next generation began to emerge October 11, and 49 flies had emerged up to November 1. The remainder of the larvae of this brood appear to be full grown, but have not yet pupated and may pass the winter in that condition. A few eggs which were deposited by the flies that emerged during October hatched early in November. On December 1 they appeared to be nearly as large as the larvae of the previous generation.

The evidence in regard to feeding habits is not yet conclusive. The female flies deposited their eggs on sound bulbs, and the larvae are equipped with rasping mouth hooks which are capable of scraping healthy tissue and of burrowing under the epidermis of the bulb scales. On the other hand, the larvae are frequently associated with decaying or fermenting bulbs or onions. It appears that the young larvae feed almost continuously but when nearly full grown they become sluggish and do not feed much prior to pupation. This suggests the possibility that in infestations under field conditions the bulbs may have been damaged by larval feeding and the decay may be a secondary infection.

Until it can be demonstrated that the larvae do not damage sound bulbs the lesser bulb fly deserves recognition as a potential pest of narcissus and onions.

PRESIDENT A. F. BURGESS: The next paper is by C. F. Doucette.

THE CATTLEYA FLY, *(ISOSOMA) EURYTOMA ORCHIDEARUM* WESTWOOD

By CHARLES F. DOUCETTE, *Junior Entomologist, Fruit Insect Investigations*
Bureau of Entomology, United States Department of Agriculture

ABSTRACT

This paper is a preliminary account of studies of the life history and control of the Cattleya Fly, *Eurytoma orchidearum* Westwood, which has become the most serious pest of the Cattleya group of orchids cultivated in the greenhouses of the United States. The durations of the several stages of the insect are given, and total three and one-half to five months for the complete life cycle of an individual. Suggestions for control involve two methods; removal of all infested growths, and semi-weekly dusting for a period of five months with a nicotine-impregnated dust mixed according to the following formula:

Kaolin	50 parts
Hydrated lime	20 parts
Dusting tobacco dust (containing 1 per cent nicotine)	25 parts
40 per cent nicotine sulphate	5 parts

One of the projects at the cooperative field station maintained by the United States Bureau of Entomology and the Pennsylvania Department of Agriculture at Willow Grove, Pa., is a study of the life history and control of the Cattleya fly, (*Isosoma*) *Eurytoma orchidearum* Westwood.

This phytophagous chalcidoid was introduced many years ago with plants of the genus *Cattleya* from the tropical regions of Central and South America. It was not considered a serious pest as long as plants could be imported to replace those killed and injured. The shutting off of the supply of these plants from the tropics by quarantine regulations of the Federal Horticultural Board has, however, made this insect the most important pest of the Cattleya plants in the greenhouses of the United States.

The plant is injured in several ways by this insect. The most important is the tunneling by the larvae in the younger growths of the plants, which prevents flowering, usually by weakening the growth, or often through destruction of the embryonic flowerbuds within the developing pseudobulbs. Another result of the feeding of these insects is the premature development of infested basal buds. This so saps the vitality of the plants that they lose their vigor, and are killed if infestations continue for three years or more.

Westwood (*6*),[1] in 1869, first reported and named this insect in England. He further described it in 1882 (*7*). It was announced in France in 1888 (*3*), and Riley and Howard (*5*) report its occurrence in Massachusetts in 1889–90, its first mention in the United States. Various later reports show that the orchid fly may be found in greenhouses in most sections of the United States, but, as far as is known, it has never been found on any out-of-door hosts here. Of the more extended accounts of its life history and control, those by Jack (*2*), Decaux (*1*), and Moore (*4*) represent more or less extended research, though none of these approaches completeness and in no case has a satisfactory method of control been given. The numerous references in horticultural papers relate in most instances to one or another of the foregoing articles.

Life History

The eggs are usually laid in the developing phloem tissue of the partially developed pseudobulbs or in the basal buds of the one-year-old pseudobulbs. Less occasionally the eggs are laid in the dormant buds at the base of pseudobulbs two and three years old. These swell and develop, although if uninfested they remain dormant. Eggs are rarely

[1]Reference is made by number (italic) to "Literature cited," p. 147.

laid in the leaves. The egg period varies from 10 to 20 days, and averages about 14 days; the variations are due primarily to differences in temperature.

After hatching, the yellowish white larvae feed on the surrounding plant tissue, enlarging the cavity gradually as they increase in size. Where several larvae are present in the same growth the cavities may eventually come together, although at the start each larva is in an entirely separate chamber. In these cavities pupation occurs and the adults emerge from the pupal cases and tunnel a passage to the exterior. The larval stage requires about 70 to 100 days for development. The pupa is white at first, changes to a shiny black 15 to 20 days after pupation, and the adult emerges 6 to 18 days after the color change. The total period from egg deposition to emergence of adults varies from 100 to 158 days.

Mating has been observed five minutes after the adults came out of the plant. Oviposition took place thirty minutes later in one case and within two hours in several instances. The adult female oviposits during a period varying up to five days, and possibly longer, although no oviposition has been observed after the fifth day. The average length of life of the adults is from 7 to 15 days. The maximum length of life observed for a female has been 23 days and for a male 18 days. Observations indicate that both sexes are entirely diurnal in their habits and exhibit very little activity if the temperature goes below 60°F. No adults have been observed to do any feeding whatever after emerging from the plant.

Control

Several factors render control very difficult. The practical impossibility of reaching the immature stages with insecticides centers such methods of attack on the adults. As a rule, the infested growths are easily detected, and their removal and destruction is a big factor in a successful control program. This method has in the past been the only approach to satisfactory control. Not every infested growth can be detected, however, so that this method can not be considered entirely satisfactory. Fumigation, since it is always done in the evening, will not prevent oviposition by adults emerging during the day, and nicotine and hydrocyanic-acid gas are not sufficiently toxic to give control; therefore this method of attack can not be considered satisfactory. At one commercial establishment spraying twice a week with a 1–200 solution of free nicotine for a period of six months caused no appreciable reduction of the infestation.

Laboratory tests with nicotine showed that a liquid spray was ineffective, but dusts impregnated with nicotine indicated a satisfactory toxicity, so that these were studied more extensively. The object in this study was to find a mixture which would retain the nicotine for a period of three or four days, an object contrary to that of most studies of nicotine-impregnated dusts, in which the most rapid volatilization is usually desired. The studies of various mixtures indicate the following as the most satisfactory for the control of the orchid fly:

Kaolin	50 parts
Hydrated lime	20 parts
Dusting tobacco dust (containing 1 per cent nicotine)	25 parts
40 per cent nicotine sulphate	5 parts

Experimentally it has been found that the adult orchid fly is killed if brought into contact with this mixture after the latter has been exposed to a greenhouse atmosphere for four days or less. This fact indicates that two applications a week will keep the orchid plants protected by killing any of the adults which happen to alight on them, thus preventing oviposition, and, if continued for a period of five months or more, the treatment will theoretically bring about extermination in any particular collection of these plants.

The use of a nicotine spray by one orchid grower has been mentioned. At his establishment approximately 10,000 blooms were cut for the Christmas season in 1919. An infestation of the Eurytoma became so serious that in the same season in 1923 only 800 flowers were cut from the same number of plants. In December, 1923, and January, 1924, a definite campaign of extermination was started. The plants were first thoroughly inspected, and all infested growths found were cut off. Incidentally, over 5,000 growths were cut off during the first two days of inspection, each containing an average of six to seven individuals, or an approximate total of over 30,000. If normally developed, each of these infested growths would have produced at least one flower, and at a minimum wholesale value of one dollar per flower the loss amounted to $5,000. A considerable number of infested growths escaped the attention of the workers, as was shown by later inspections. A commercial dusting mixture of hydrated lime impregnated with 5 per cent of free nicotine (2 per cent nicotine content) was applied three times a week for four months. Unfortunately, the blooming of one variety necessitated the cessation of the dusting at the end of four months, so that complete extermination was not accomplished. In the spring and summer the new growths developed normally, and at the present time

it is extremely difficult to locate an infested growth or an adult fly in the greenhouse. The crop this winter will probably total 6,000 flowers. In this case a pest which caused a loss amounting to upwards of $50,000 has been practically eliminated.

Recommendations

In the light of our present knowledge of this insect it is suggested as a basis for control that immediately after the plants are through flowering they be thoroughly inspected and all infested growths removed and destroyed. Dusting twice a week for a period of five months or longer with the mixture already described in this article will prevent oviposition by any adults emerging from growths escaping the inspection, and from which all adults will have emerged at the end of five months.

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President A. F. Burgess: It is only within the last few years that we have had very many papers read before this Association on greenhouse insects, and I think this is a very fine development because greenhouses are run intensively. The product is very valuable and there is a fine opportunity for entomological work along that line, and it is encouraging to the Association that more interest is being taken and more work done of that character.

President A. F. Burgess: The next is a paper by Harry S. Smith.

THE COMMERCIAL DEVELOPMENT OF BIOLOGICAL CONTROL IN CALIFORNIA

By Harry S. Smith, *University of California, Citrus Experiment Station*

Abstract

Most attempts at biological control of insect pests have consisted in the simple introduction and establishment of entomophagous insects, rather than in the con-

tinous laboratory propagation and distribution of these insects in order to force them to a condition of permanent dominance. This latter type of work has been developed in a large commercial way against the mealybugs attacking citrus in California and has proved very sucessful as well as economical. There are now ten local insectaries engaged in this work in California in addition to several private ones. $33,800.00 is invested in equipment for this work. Operating expenses for the past season were $48,750.00, and over four million *Cryptolaemus montrouzieri* were propagated in the insectaries and distributed in the infested groves.

The commercial control of an insect pest by the continuous laboratory production of certain of its natural enemies in quantity and their systematic liberation in the infested area is of such infrequent occurrence that it seems worthy of record. Beneficial insects have, it is true, been produced in large quantities and distributed over the infested area but, so far as known to the writer this has been done with the object of establishing a species in a new fauna and for hastening its distribution, rather than as a direct practical control measure.

That the efficiency of a predatory insect can, by artificial propagation and distribution, be extraordinarily increased, has been proved beyond any doubt. More than that, it can be made to do effective work even under environmental conditions which are so unfavorable to its habits that it would soon disappear from the locality, were it not given assistance.

Since 1918 the citrus growers of California have come to rely more and more on the biological method for control of mealybugs until it has become practically the only method in use at the present time.

The mealybugs have been the most dangerous pests with which the citrus growers have had to contend, not only because of the serious effect of their attack on tree and fruit, but because of inability to control them by spraying or fumigation. These facts are responsible for the extensive development of the biological method for their control in California.

Reliance is placed largely in the use of a single predatory insect, the Coccinellid *Cryptolaemus montrouzieri*, well known to entomologists as one of Koebele's introductions from Australia during his second trip to that country in 1892. During the years immediately following its introduction it was propagated in considerable numbers and thoroughly distributed throughout the state, wherever mealybugs were found. It became permanently established in several localities in southern California and has maintained itself in varying numbers ever since. At times, where conditions were particularly satisfactory, it became sufficiently abundant to check the ravages of its host, although this always occurred after very serious damage had been done to the orchard.

Mr. C. P. Clausen, writing in 1915,[1] after a thorough study, described the status of the ladybird as follows:

"Much has been claimed for this Coccinellid as a natural enemy of the mealybug in southern California since its introduction into the state some time between 1890 and 1895. In 1909 it was introduced into Ventura County and during the following season was reported to have done remarkable work. At present only occasional specimens can be found, even in heavily infested groves, and there is little reason to believe that this parasite is in any very large measure responsible for the general decline in the severity of the mealybug infestation in that county since that time.

"In San Diego County several isolated instances of fairly effective work have been observed, but efforts to secure a general distribution and effectiveness over the entire infested area have not resulted satisfactorily. Repeated attempts to introduce this enemy into the valleys not immediately adjacent to the coast have uniformly resulted in failure. From these results it appears that there is very little hope for satisfactory results outside of certain limited areas near the coast, where the temperature and humidity conditions are more favorable for the development of the insect."

The above is quoted for the reason that it gives what may be considered a very fair statement of facts regarding this ladybird at the time it was written (1915), and by contrast with the present status of Cryptolaemus shows what has been accomplished since then by the rearing and distribution of this species in large numbers.

At this time there are in California approximately 20,000 acres of citrus orchards infested with mealybugs. Following two years of the most serious mealybug outbreak on record the pest has been brought into complete subjection by the use of the biological method, consisting almost entirely of the propagation and distribution of Cryptolaemus by local insectaries operated in the infested districts. These insectaries are maintained by the fruit growers' associations and by the counties themselves, in which latter case they are under the jurisdiction of the County Horticultural Commissioners. Each of the seven principal citrus producing counties in southern California maintains an insectary for this work, but they are financed by various methods. Four of the county insectaries are supported by means of direct appropriations from the County Board of Supervisors. One is supported by a voluntary levy by the fruit growers' associations of one-fourth cent per box of packed fruit. The

[1]Bull. 285, Univ. of Calif., College of Agriculture.

fund thus accumulated is used for the production of Cryptolaemus and the County Horticultural Commissioner is given full discretion as to where and under what conditions the ladybirds are colonized. A very broad policy has been followed, the beneficial insects being placed wherever they are needed, even though the particular grower in whose orchard they are placed is not a contributor to the fund. It is felt that this policy is well worth while as a matter of protection. A large number of growers who have no mealybugs contribute to the fund looking upon it as a matter of insurance against further spread of the pest.

A second county insectary is operated on a self-supporting basis, charging for the ladybirds at a rate of one cent each. The growers organizations are billed for this expense by the county, one-third of the amount being collected from the individual grower within whose grove the insects are colonized, the remaining two-thirds supplied by the organization as a whole. This seems to be an equitable way of supporting the work, since the entire district is interested in keeping the pest under control and thus restricting its further spread, while it seems logical that the grower who has an infested orchard should contribute somewhat more heavily to the cost of the work than one who has a clean orchard. The superintendent of the insectary has complete jurisdiction over the time, place and extent of the colonization of insectary-produced material. Still another county insectary is operated on a basis of direct collection from the individual grower of the cost of the insects colonized in his grove, although this method is likely to be superseded by one of the other more equitable plans.

Some of the most efficient insectary organizations are maintained by the local fruit-growers' associations themselves.

Each insectary is operated under the direct supervision of a superintendent who in every case is a man who has had several years experience in the propagation of beneficial insects. These men have formed an organization known as the Insectary Operators Association, which meets at stated intervals for discussion of their mutual problems.

The biological control of citrus mealybugs has now passed the experimental stage and is developing in a large commercial way. At the present time, according to figures supplied by the Insectary operators, there is invested in southern California in buildings and equipment for this work approximately $33,800.00. The cost of operation of the insectaries during the past season, including labor and supplies, has been $45,377.32. A total of 4,038,238 *Cryptolaemus montrouzieri* for the season have been produced and colonized, and the total citrus acreage infested with mealy-

bugs is approximately 20,000. That this method of control, in addition to being effective, is very economical, is shown by these figures. Assuming that only one-third of the infested acreage was sufficiently serious to justify spraying, and assuming that spraying was a satisfactory control measure, it would have cost the growers about $200,000 to have sprayed their groves once, and it requires several sprayings per year to control this pest. This is opposed to a cost of $45,377.32 for operating the insectaries during the past season. Interest and depreciation on equipment would bring this figure up to about $48,750.00, leaving still a very large margin in favor of this method. Due to improvements in propagation methods, the production costs will be greatly reduced during the coming year.

It has been shown on many occasions that a heavily infested grove can soon be made commercially clean by the use of this method. Whether or not, by the continued production and distribution of Cryptolaemus on a large scale, the pest can be *kept down* after being once subjugated, remains to be conclusively proven, but it is the writer's opinion that this can be done, particularly as production costs are certain to be very greatly reduced under the above figures.

One of the most interesting features of this work has been that even in areas where Cryptolaemus, left to its own devices, has not been able to maintain itself, as shown in the quotation from Clausen, it can be made to dominate its host by continued colonization in those areas. This is particularly true in San Bernardino County and parts of Los Angeles County.

While the production and distribution of Cryptolaemus has been the main function of these insectaries they have, in addition, handled many other beneficial insects most of which are a by-product of the Cryptolaemus work. Many of the insectary operators do not record these other species but in the reports supplied to me for the past season are records of the colonization of 1,325,555 *Leptomastidea abnormis*, 168,045 lacewings, 15,355 *Aphycus lounsburyi*, 16,700 *Chilocorus bivulnerus*, 3,600 *Orcus chalybeus*, 203,350 *Rhizobius* sp. and 102,320 *Scymnus binaevatus*. A single insectary has, during the two years since it has been in operation, handled 10,079,906 individual beneficial insects.

From the standpoint of one primarily engaged in the introduction and establishment of exotic species of beneficial insects, the presence of these many insectaries in charge of men skilled in the handling of such insects is particularly helpful. Once a species has been determined to be desirable for colonization and a sufficient supply of breeding stock is

on hand, it is only necessary to supply the insectary operators with colonies in order to obtain rapid distribution under many varied climatic conditions, thus assuring its establishment and indicating promptly its economic possibilities.

PRESIDENT A. F. BURGESS: I am sure we have all been very much interested in this paper. It was my privilege last summer to visit a few of these insectaries in California, and it is certainly a wonderful opportunity and a unique experience to see work of this sort being conducted on such an extensive scale.

MR. E. P. FELT: I would like to ask Mr. Smith whether in his opinion there will be an opportunity for the extension of the biological method of control under Eastern conditions.

MR. HARRY S. SMITH: I think that the type of work I have been describing would probably not be adaptable to Eastern conditions for the reason that it is rather expensive as compared with the methods you are using at the present time. It costs to control citrus pests about fifty dollars an acre and we can spend twenty or thirty dollars in producing these insects for control purposes. But in the case of a deciduous orchard, where I imagine you can carry on a treatment for seven, eight or ten dollars, it is a question whether you can use this treatment to any great extent.

PRESIDENT A. F. BURGESS: The next is a paper by E. P. Felt.

THE DISSEMINATION OF INSECTS BY AIR CURRENTS

By E. P. FELT, *State Entomologist, Albany, N. Y.*

ABSTRACT

An application of recently acquired knowledge respecting air currents and the behavior of drifting balloons, suggests that such insects as the cotton moth, *Alabama argillacea*, the corn ear worm, *Chloridea, obsoleta* and a number of other southern forms really drift on the somewhat prevailing southerly or southwesterly winds, especially as convectional air currents over heated areas would very likely carry them 1000 feet or more above the earth. Mosquitoes have been observed 3000 feet above the surface. The monarch butterfly, *Anosia plexippus*, has spread widely in the Pacific ocean within historic times, presumably taking advantage of favorable winds both in these wanderings and its seasonal migrations. Lengthy flights of butterflies in Europe are probably explainable in the same way. The drifting and distribution of ballooning spiders is obviously due to winds and closely parallels what has been observed among insects.

This is a brief summarization of some of the more significant data respecting the dissemination of insects by air currents, interpreted with

the aid of recently gained facts. There are excellent reasons for believing that some of the more noteworthy cases of wide distribution are due more to the insects drifting with air currents rather than to purposive flight, though certain cases suggest a more or less intelligent taking advantage of favorable winds. Let us first summarize certain somewhat recently discovered facts, in regard to aviation and winds.

It is known, in the first place, that such a comparatively minor physical object as a state road may produce uprushing convectional currents which may make themselves evident at a height of 1000 feet or more. The extensive balloon work conducted by the New York State Conservation Commission the past two seasons has shown that balloons inflated for a minimum buoyancy may be carried by these upward currents to elevations of 1000 feet and probably higher, that the average velocity of these drifting balloons is approximately 17 miles per hour, and that some at least may float through the air at 50, 75 or even under certain conditions at 100 miles per hour. The past season a number of these balloons drifted several hundred miles, a few 400 miles and over, and one nearly 800 miles, mostly within 24 hours. These records suggest the carrying power of the winds, especially those somewhat above the surface of the earth.

Another matter worthy of note, namely, the recent gliding record in Europe, proved that a man can remain supported in the air for upwards of 9 hours. If this be possible for an animal without an inherited provision for flight, should we not expect as much from forms nature has endowed with wings? Soaring is well known among birds and is certainly practiced to some extent by insects. One objection, possibly, is the fact that many insects do not venture from shelter during windy periods. This obviously applied to observations made near the surface. It is not necessary to assume that upward currents are boisterous; in fact our balloons usually rose very gently. It is entirely possible for these upward air currents over a heated area to carry the insects gently to the more rapid breezes above, provided they simply maintain themselves upon the air, and once well above the surface of the earth, considerable velocity is not necessarily accompanied by turbulence in the air.

Let us refer briefly to the occasional appearance at lights in the northern, mostly northeastern states and southern Canada of millions of cotton moths, *Alabama argillacea* Hubn., most of the specimens being in as perfect a condition as though they had just issued from the pupa. This latter certainly does not suggest prolonged flight and a considerable expenditure of energy. Is it not more reasonable to think these insects

may have risen from the cotton fields on gentle upward currents and drifted through the night until they dropped at lights in widely scattered cities and villages? The velocity would be about that of some of our more rapidly drifting balloons. The prevailing winds in the United States have a strong westerly component. It appears significant that cotton moth flights seem to be restricted largely to areas north or northeast of the cotton fields.

The corn ear worm, *Chloridea obsoleta* Fab., probably does not winter in any numbers north of southern Pennsylvania and the Ohio River, yet occasionally it becomes extremely abundant and injurious even in southern Canada. The known facts do not suggest the flight of such enormous numbers as in the case of the cotton moth and yet it works northward somewhat rapidly, probably drifting with the wind. The sub-tropical *Erebus odora* Linn. very probably comes north on the night winds and occasionally makes its way even to southern Canada.

The following is a short list of sub-tropical forms taken in northern United States or Canada and here again the records are mostly from northeastern areas:

Erebus odora Linn., northern United States and southern Canada.

Thysania zenobia Cram., N. E. (Johnson) and N. Y.

Tropical sphingid, *Argeus labruscae* Linn., Aroostook Co., Me. (Johnson).

Mexican dexid, *Cholomyia inaequipes* Bigot, Ithaca, N. Y., (Johannsen), L. I., N. Y. and N. E. (Johnson).

These records can represent only a very small proportion of the individuals which found their way north and the same must be true as to the number of species.

The monarch butterfly, *Anosia plexippus* Linn., is an insect which moves freely over wide areas, it being unable to survive the winter north of sub-tropical areas, yet each season it makes its way into Canada, sometimes well toward the Arctic circle, and available records indicate a wide distribution in the Pacific Islands, the spread in the latter having occurred during the last half of the preceding century and presumably closely followed the establishment of the food plant in those sections. Southern migrations of the monarch have been repeatedly recorded in this country and there are a number of records of butterflies occurring in the air up to the limit of visibility. We are inclined to believe that even in the case of this well known insect it drifts rather rapidly, frequently for relatively great distances, though probably not so rapidly or for such long distances as in the case of the cotton moth.

The great variability of the lower air currents during the daylight hours may afford a partial explanation of this difference. Furthermore, the high visibility in the day suggests that diurnals might not allow themselves to rise so freely with upward air currents as the nocturnals, the latter presumably being limited in judging height by the lower visibility during the night.

The movements of the cosmopolitan painted lady, *Vanessa cardui* Linn., are worthy of notice. An immense number appeared in May and early June in 1879 in central Europe, even crossing the Alps and suggesting a flight from an immense distance, some of the specimens at least being badly worn. Oberthur captured specimens at Rennes on the 10th of June and stated that they belong to a very characteristic African type. The insects remain on the wing the entire winter in northern Africa and breed throughout the season in Egypt. The flight of this insect before the regular appearance of the indigenous brood also suggests an exotic origin. Scudder refers to other similar spring flights which are recorded in less detail and occurred in the years 1741, 1790, 1798, 1826 and 1851, and also mentions an exceptional flight in October, 1827.

Somewhat similar movements occur with other insects. Prof. Stanley B. Freeborn informs us that he met with swarms of a mosquito, *Aedes dorsalis* Meign., at an elevation of about 3000 feet in the central Sacramento valley in 1919. This, taken in connection with the record by the late Dr. John B. Smith, of salt marsh mosquitoes drifting 40 miles, suggests that mosquitoes might drift in this manner. Mr. Stewart Lockwood informs us that *Melanoplus atlanis* Say was observed by Mr. C. L. Corkins in North Dakota at an elevation of 2000 feet, though the bulk of the grasshoppers was several hundred feet lower. In the case of both mosquitoes and grasshoppers, we have unquestioned evidence of insects occurring at considerable heights in the air. Incidentally, ballooning spiders are obviously carried by the winds. McCook (American Spiders, Vol. 2, 1890, pages 257–282) summarizes the data in relation to this and states that spiders have been observed at a height of 1000 or 2000 feet and even as far as 200 miles from the nearest land. He has even assembled data which suggests a circumnavigation of the globe, in other words, a world wide distribution in the tropics of a species presumably carried by the trade winds. A similar distribution appears to obtain in the case of certain very fragile, minute gall midges. Both suggesting that something similar may be true of Anosia.

The experience of the last two seasons shows that a number of balloons

came to the surface on or near water, probably dropping with descending air currents. Such air movements over the Great Lakes offer exceptional facilities for the collection of insects. Dr. James G. Needham records such a condition in 1899, the western shore of Lake Michigan being thickly strewn after a storm with many insects, among them an extremely large proportion of crickets, *Nemobius fasciatus* DeG. Two days before the visit to the beach there had been a heavy wind and thunder storm. It is suggested that the thunder storm forced the insects down, the northeast wind gradually bringing them ashore. The normal occurrence of insects over water is also suggested by reports from twenty lighthouse keepers on the Great Lakes and the New York and New England coast, showing that insects come to lights commonly in midsummer, even if the lights be miles from land.

The above considerations lead the writer to believe that wind currents may be more important factors in distributing insects than most of us have suspected.

MR. H. A. GOSSARD: I would like to ask Dr. Felt if he has ever had occasion to suspect that the Hessian fly goes that way.

MR. E. P. FELT: There are records to show distribution. I think Mr. McColloch obtained some evidence a few years ago to show that a Hessian fly was picked up on a screen at quite an elevation above the ground. In answer to that question I will say "Yes, I think so."

Another thing: Perhaps you remember my asking a question in regard to the Mexican bean beetle yesterday afternoon, as to why there was no southern spread to amount to anything. I wanted to find out whether there were any physical or agricultural obstacles to prevent its going South. Now, the prevailing winds, I would expect, would carry that insect northerly or northeasterly.

MR. G. A. DEAN: With regard to the height that insects may fly, the grasshopper (*Melanoplus atlanis*) is found out in Montana in the Glacier County Mountains. The snow line must be about ten thousand or eleven thousand feet high, although possibly not over ten thousand. The forest rangers there find the grasshoppers up as far as that snow line in their migrations. Whether they are down lower in the valley and go up to this height, we don't know, but they are found up to that altitude. In the "Grasshopper Glacier" which is in one of the highest ranges of mountains in Montana, the mountains at Cooke City (that glacier being about eleven or twelve thousand feet) there are grasshoppers by the tens of thousands and they are undoubtedly collecting in there right along

and they must come in from high flights because it is a long way before you get to any of the elevated valleys from that grasshopper glacier, where you can get down at the base and dig as many grasshoppers out of the ice as you wish.

MR. E. P. FELT: May I supplement those statements? I have a notion or two in regard to wind currents which may be useful in suggesting explanations in regard to some of these conditions.

In the first place, take eastern New York, for example: we have strong westerly winds and these, as they cross the Berkshires, tend to flatten anything from the east. Winds over a lake or a body of water tend to drop on account of the cooling surface. The same thing probably obtains with winds crossing a glacier. That is, the winds tend to drop drifting materials. Consequently, bodies of water, glaciers, and so forth, are natural collectors or traps. If there is a prevailing wind in one direction, even if there is a barrier of mountains, it is bound to surmount them, though a portion of the current as it comes over the barrier may turn down. There is a splitting; a part goes over and a part forms an under-current which may drop insects. There are several mechanical reasons why we should obtain collections of insects under such conditions.

Another thing: If my theory is correct we should find a number of southern forms on isolated mountain peaks, Mt. Washington, for example. There is some evidence of that kind. One of the difficulties is our records concerning the distribution of individual species are so fragmentary that it is somewhat hazardous to draw positive conclusions.

MR. F. C. BISHOPP: I just want to say in connection with our studies of the flight of Muscoid flies, we have encountered some difficulties that seemed insurmountable, except for some such explanation as Dr. Felt presents. We would hardly expect strong flying Diptera to enter into those upper air currents, yet I don't think that Dr. Felt feels that was entirely impossible.

In connection with the screw worm particularly we have the reinfestation of the country from the south each year at such a rapid rate that it seems almost impossible that we can have a gradual breeding out of the flies step by step northward, and spread by that method.

That, I think, and Dr. Felt's remarks would give a possible explanation of the spread of some of those strong flying Diptera.

MR. E. P. FELT: Mr. Bishopp has referred to strong flying insects. If I view this rightly, it isn't necessarily the strong flyer, it is simply the

insect that will leave the ground and stay in the air. The air does the rest. One hundred miles an hour will carry them a good ways.

PRESIDENT A. F. BURGESS: The next paper is by R. W. Doane.

MR. R. W. DOANE: I must have been in a particularly optimistic mood when I selected this title for the paper I am to present because, of course, we realize that the term "stability" when it refers to names of insects is only relative.

This question of the scientific names of insects is as old as the history of mankind. You can very well imagine Cain and Abel sitting in the field eating their lunch. The conversation lags somewhat. Finally, of course, they go back to the old discussion as to the proper scientific name of the worm which Adam found in the apple that Eve gave him to eat. (Laughter.) Adam had expressed himself in a word or two, rather forcibly, and the words seemed to be in some foreign language. Eve supposed he was giving the insect a scientific name.

In this conversation which Cain and Abel were having Cain stood for priority at any cost (laughter) and said that Adam had given the insect its name. Abel said that Adam didn't really mean to give the insect its name at that time; anyway, he had only half the insect as the other half had disappeared and had made a larval name from half an insect.

Cain finally grew impatient at Abel's stupidity and picked up a club and tried to beat a little understanding into Abel's tough skull. He happened to hit a little bit too hard and so we have the history of the first crime. It was antedated, and it was decided unanimously in favor of Cain's proposition, of course.

That is the only time, I understand, there has ever been a definite decision in regard to the name of an insect. (Laughter.)

With your consent, I am going to change the title of this paper from "Stability in Scientific Names" to "Scientific Names of Economic Insects" and will take up the discussion from that point.

SCIENTIFIC NAMES OF ECONOMIC INSECTS

By R. W. DOANE, *Stanford University, Calif.*

ABSTRACT

Attention is called to the fact that there is even more confusion among scientific names than among the common names for many of our insects of economic importance, and a suggestion is made that our Committee on Nomenclature be instructed to provide a list of scientific names which shall be presented to the Association for approval, just as the list of common names has been prepared and approved.

At the 16th meeting of the American Association of Economic Entomologists, December 1903, Professor Herbert Osborn discussed the con-

fusion resulting from the repeated changes in the names of insects, and suggested that a committee be appointed to adopt common names for a number of our insects that are of economic importance, in order that we might have a standard uniform set of common names that might be used not only by the professional entomologists but by the layman as well. Such a committee was appointed and for more than twenty years it has been recommending the adoption of certain common names, and it has published from time to time lists of these names in the official organ of this Association. I believe that the last list which was sent out in mimeographed form brought the number of names thus recommended to about 1000. The Association has voted to accept the recommendations of the committee and I am sure that we all appreciate the service that the members of this committee have rendered to the economic entomologists.

In Professor Osborn's article just referred to, he called attention to the fact that the common oyster-shell scale had, within a short period of time, been masquerading under five different scientific names including various combinations of three generic and four specific names. In addition to these I find that this insect has, at various times, been known or, at least, has been described, under four other generic and nine other specific names! And all the while there was no question about the identity of the insect. These various names were proposed by different authors in an attempt to stabilize the nomenclature.

I need only mention the Lecanium group or the Pseudococcus group, or almost any other group of Coccidae, to call up a veritable nightmare of confusion of names. How many of us who have not followed the literature on mosquitoes very closely, would dare to give the generic or even the specific names of half a dozen common species, without fear of being "called down" for being out of date? Other examples almost without end might be cited, showing the confusion due to constant and seemingly unending changes in scientific names.

The system of binomial nomenclature was adopted in order that animals and plants might have definite fixed names by which they might be known in all civilized countries. The chaotic condition brought about by the commendable attempt to stabilize our scientific names, principally by following the "law of priority" at any cost, has made the common names of many of our insects and other animals more stable and much better known than the scientific names. This is true not only in America but in Europe as well, although the Europeans are much more conservative than we are in this, as well as in many other respects. During re-

cent conferences with some of the leading European entomologists, I frequently found that we could understand each other much better when we used the common English names for insects than when we used the Latin names. *Aedes aegypti* meant nothing to most of them, but there was never the slightest confusion when we used the name "yellow fever mosquito."

In order that I may not be misunderstood, let me say that I am not objecting in any way to the use of scientific names. We must have them. And I care not at all whether the yellow fever mosquito is called *Culex aegypti*, *C. argenteus*, *C. fasciatus*, *C. calopus*, *Stegomyia fasciata*, *Stegomyia calopus*, *Aedes calopus*, *Aedes argenteus* or *Aedes aegypti*, or any of the other 25 or 30 combinations of generic and specific names that have been used. But I do believe that the researches and discussions and publications in regard to the proper scientific name for this mosquito, as well as for many other insects, have gone far enough. As long as the question remains one of personal opinion, and especially as the personal opinions of some of our specialists change from year to year or from month to month, there should be some tribunal before which the evidence could be presented and a decision reached that would be acceptable to all.

Now, briefly, what I propose is this: That our Committee on Nomenclature, which has done so much toward stabilizing the common names of insects, be asked to turn its attention to the scientific names as well and recommend a list of names that we, as economic entomologists, at least, may use in our publications.

In reaching its decisions the Committee would necessarily call to its aid specialists in the various orders or groups with which it was dealing. This Committee should also seek the cooperation of the British Committee on Entomological Nomenclature, and of any other committees that might be appointed by any organization interested in stabilizing entomological names. Indeed the cooperation of the International Entomological Committee on Nomenclature which was appointed by the Executive Committee of the 2nd International Congress of Entomology in 1912, might be asked for. I can, however, find no record of anything that that Committee has done since it was appointed. The British National Committee has, however, been more active and has handed down a number of decisions.

There will, of course, be differences of opinion, especially among different national committees in regard to the proper names to use for certain

insects. Such questions should be referred to the International Committee on Zoological Nomenclature whose decision would be final.

The list of scientific names already published with the list of common names might very well serve as a starting point. And notice might be served that if after one year there was no objection to the list as it stands, the list would be approved and no changes would be made except by vote of a majority of the Committee acting with the other national and international committees. There is no question but that most of these names would stand as now given. The others should receive early attention in order that we may soon have an official list of scientific names that is backed by the authority of the various European and American entomological organizations and by the International Committee on Zoological Nomenclature.

And I wish to call particular attention to the fact that this plan does not make it impossible to change the scientific names of insects after they have been adopted by the Committee, but it does not leave the changing to the whims or personal opinion of a single worker. If any systematic worker of repute can convince the Committee on Nomenclature that it is important that a change should be made, the Committee could make the change and announce their action in the official organ of this organization. Any radical change or changes of great importance should be referred to the International Committee on Zoological Nomenclature. Under the present plan any one who cares to may suggest a change in a scientific name, and those of us who believe that he is a careful worker and investigator will accept the change, and others who do not like his work will go on using the old name, and thus for a long while, possibly for years, we will have two or three sets of scientific names used for a common well known insect. At present the suggested change may be made in some more or less obscure publication or in a way that does not attract general attention and so it may escape the notice even of other workers in the same group of insects. If the attention of the Committee on Nomenclature was called to the suggested change and the change met with their approval, the attention of all the workers could be called to the fact.

The plan that I suggest does not call for two sets of scientific names, one to be used by the economic entomologist and another to be used by the systematic workers, for as soon as it is shown that the systematic workers are agreed that a name should be changed the Committee would doubtless make the change and it would be adopted by all.

It is said that there are some 400,000 kinds of insects known; without

waiting for the systematic workers to agree among themselves as to just what are the proper names for all of these, let us decide on the names of about 1000 of them and leave the other 399,000 for the systematists to play with as much as they like.

MR. E. P. FELT: It seems to me the matter Professor Doane has brought out is really an important one and it is not easy to get at an entirely satisfactory solution. If our Committee on Nomenclature would suggest from year to year some of the scientific names which have sufficient stability so that we could use them generally, I believe it would be a good thing.

In my own work I am in doubt sometimes as to what to use, whether to use the latest available, published in some foot-note or coming over the radio or something of that kind, or whether to go back to a standard catalog or list. Usually we go back to something standardized, a catalog or list, and I think that is fairly safe.

MR. R. W. DOANE: Which is all a question of knowing what is the best name to use. If we had some list of names approved by the organization as a whole, we could use it until a change was necessary.

MR. E. P. FELT: How many would refer back to that standardized list if it were gotten together? Take a specific case: How many times do you refer back to the list of authorized common names to see if you get just the right combination?

MR. R. W. DOANE: I do very frequently.

MR. E. P. FELT: I hardly ever do. (Laughter.) I don't intend to violate good practice or anything of that kind, but usually I don't refer to the list.

PRESIDENT A. F. BURGESS: I suppose it is the Editor's privilege to do as he is minded. (Laughter.)

I would suggest, though, that this is an important matter and one that is worthy of consideration by the members. I would also suggest that it might be well for the members to talk the matter over between now and the end of the session; if it seems desirable to refer it to the Committee on Nomenclature, that it be taken up at the last business session of the meeting and some action taken along that line.

PRESIDENT A. F. BURGESS: The next paper is by J. G. Sanders.

ENTOMOLOGISTS ENTERING COMMERCIAL FIELDS

By J. G. SANDERS, *Philadelphia, Pa.*

ABSTRACT

All economic entomologists are commercial entomologists or entomologists for commercial undertakings, in the ultimate analysis, for trade and commerce is the mainspring of the world.

A distinction, by a somewhat invidious comparison, has been made between federal and state entomologists and those who are engaged directly with insecticide manufacturers or distributors. This should not exist, because an economic entomologist still retains his identity and worth, irrespective of the source of his remuneration.

In fact most entomologists connected with commercial concerns are in a position to do a genuine service to a large constituency, oftentimes having a much broader grasp of the country's entomological problems than those confined to a single state or station.

Commercial companies have lately discovered that a trained entomologist, provided he has the right personality and selling ability, is vastly superior to the mere "go-getter" salesman without a knowledge of the science. It is easier to select the properly trained entomologist and give him three months of salesmanship training than to try to crowd four years of entomology and allied subjects into a mere salesman in a similar time.

Let us therefore look upon the recent movement of entomologists to commercial concerns with delight and hope for more efficient service and products than in the earlier days.

We will always have insecticide salesmen, so let us have the best trained men in the field, and let us give them all the encouragement and assistance possible.

In the past there has been great reluctance shown in mentioning the products of any company, often to the disadvantage of a very excellent product and to the temporary advantage of an inferior article, at least until the growers made their own determination of quality.

Commercial concerns, having attached their names to their products stand or fall by them. They are (or should be) willing to have an unbiased and accurate report on the merits or demerits of their product. Hence let us have more exact reports naming the articles of merchandise treated. If there are failures or faults, the manufacturers should be glad to correct them.

PRESIDENT A. F. BURGESS: I don't think that the Association as an Association makes any distinction in its membership or in any way between the men who are doing research work, control work, quarantine work, commercial work or any other kind of work connected with entomology, and that is as it should be—we should make no distinctions.

PRESIDENT A. F. BURGESS: The next paper is by S. S. Crossman.

FOREIGN TRAVEL AND ENTOMOLOGISTS MET WHILE SEARCHING FOR ENEMIES OF THE GIPSY MOTH

By S. S. CROSSMAN, *Entomologist, Gipsy and Brown-tail moth Investigations, Bureau of Entomology*

ABSTRACT

A brief outline of the area covered and foreign entomologists visited during recent travels in Europe and northern Africa while investigating gipsy moth and brown-tail moth infestations with a view of obtaining insect parasites and predators for introduction into the United States.

At the meeting of this Association held a year ago at Cincinnati, Ohio, I read a paper prepared by Mr. R. T. Webber and myself entitled "Recent European Investigations of Parasites of the Gipsy Moth, *Porthetria dispar* L., and the Brown-tail Moth, *Euproctis chrysorrhoea* L." in which may be found the following statement: "This paper must be much abridged so that very little can be told of the details of the work. Neither can it be possible to mention by name many European entomologists who by their interest and able assistance made the work more pleasant and helped materially in the results accomplished." In this paper mention will be made of the many entomologists whom I have had the pleasure of interviewing. They have helped much in our search for parasites by their intimate knowledge of insect conditions in their countries and by obtaining from proper officials whatever papers were required for travel in the government-owned forests. Their official and personal interest has been of great aid to the American entomologists who have had the privilege of carrying on this foreign work.

During the winter of 1921–1922 Mr. A. F. Burgess, in charge of Gipsy Moth and Brown-tail Moth investigations, started again the foreign work which had to be discontinued because of the conditions in Europe. Accordingly Dr. J. N. Summers spent the months from February to August of 1922 and 1923 in Japan. I spent about the same months during these years and also in 1924 in Europe. Before starting on the foreign work a consultation was held with Dr. L. O. Howard, Chief of the Bureau of Entomology. Dr. Howard, owing to his wide experience and long association with the biological control of insects, gave us much helpful advice and the names of many foreign entomologists to be interviewed.

In the early spring of 1922 I went alone to Europe. In 1923 I was accompanied by Mr. R. T. Webber, who spent much of his time in Central Europe. In February, 1924, Mr. S. M. Dohanian went with Mr. Webber and me. During this year Mr. Webber spent most of his time

in central and southeastern Europe while Mr. Dohanian investigated gipsy moth parasite conditions in Spain.

During these three years of foreign travel the moth conditions in fourteen countries have been personally investigated. In addition, correspondence has been had with entomologists of several countries which could not be visited.

In France, Dr. Paul Marchal, Director of the Entomological Station of Paris and Professor of Applied Zoology at the National Agricultural Institute in Paris, is particularly interested in the biological control of injurious insects. Of special interest and value were the conferences held with this eminent scientist and the Station Entomologist, Dr. Paul Vayssière, who is a general entomologist and specialist on the Coccidae, and his assistant in Applied Entomology, M. B. Trouvelot. The scarcity of the gipsy moth in France during the last three years, however, has made it impossible for us to avail ourselves of Dr. Marchal's kind offers of assistance.

At the Natural History Museum in Paris, Baron J. Surcouf, Chief of the Zoological Work of the Colonial Laboratory and M. E. Séguy of the Entomological Laboratory of the Museum were interviewed. They are particularly interested in the Diptera. Dr. J. Villeneuve, a physician and one of the greatest authorities on the Tachinidae, has been visited several times at his home in a suburb of Paris. A very pleasant evening was spent at the Entomological Society of France where many members were met, with whom our project was discussed.

After having talked over the gipsy moth situation with such an array of entomologists and having learned of the general scarcity of the insect in France, it was not necessary to scout the area thoroughly. A few well separated sections of the country were inspected but no infestations were found excepting a very light infestation along the south coast.

In the southern part of France, at Hyères, is located the European Parasite Laboratory of the United States Bureau of Entomology. At this laboratory Dr. W. R. Thompson, H. L. Parker and K. W. Babcock and *M*. Paul Genieys are studying the natural control of the European corn borer, *Pyrausta nubilalis* Hubner, and sending the parasitic enemies of this insect to America for colonization. Mr. T. R. Chamberlain of the Bureau of Entomology had his headquarters at this laboratory in 1922 and 1923 while investigating the parasites of the alfalfa weevil, *Phytonomus posticus* Gyll.

Several conferences have been held at the National Museum of Natural Sciences at Madrid, Spain, with the Director, Dr. Ignacio Bolivar

and two of his associates, one of whom is his son, Dr. Candido Bolivar y Pieltain, and the other Dr. Ricardo García Mercet, a specialist on the Encyrtidae. The elder Bolivar in addition to being a general zoologist of renown, is a specialist on the Coleoptera of Europe and on the Orthoptera of the world. His son is specializing in the same groups as well as in the Chalcididae and is giving a considerable part of his time to the development of certain phases of economic entomology in Spain. After kindly offering to aid in our work in all possible ways, Dr. Bolivar made arrangements for us to meet Dr. Manuel Aulló Costilla, Chief of the Service for the Study and Extinction of Forest Plagues and Director of the Laboratory of the Forest Fauna of Spain.

Dr. Aulló is building up a fine economic entomological organization. In his laboratory he has two excellent assistants in Messrs. Germán Marina and Bautista Diaz and an able field assistant in Mr. Angel Riesgo. This work was started in 1918 and now has several field laboratories. His Madrid laboratory, located at the edge of the Royal Forest, is one of the most modern insect laboratories which I have visited in Europe. Each year they are carrying on control projects against the most damaging forest and shade tree pests. Some of their major projects are against the gipsy moth, *P. dispar* L.; the pine procession moth, *Thaumetopoca pityocampa* Schiff.; *Dendrolimus pini* L., and the nonne, *Lymantria monacha* L. Modern methods are being used such as tree banding and creosoting of gipsy moth eggs. Last year the most modern high power sprayer obtainable was purchased in the United States and delivered at Madrid. In addition to the artificial control work Dr. Aulló has taken advantage of the aid which may be obtained by the use of parasitic insects. In connection with his campaign against the gipsy moth, he has transferred a number of species of parasites from locations where they occurred to areas where they were absent. There have been despatched from the Gipsy Moth Laboratory at Melrose Highlands, Mass., to Dr. Aulló at Madrid, *Schedius kuvanae* How., a gipsy moth egg parasite which has been successfully introduced into the United States from Japan.

In 1918 Dr. Aulló organized a forest insect pest survey of Spain. He had a map of the country prepared, showing the locations of all forest insects which were in particular abundance. This map is kept up to date and revised as insect conditions change, and is very serviceable.

During the gipsy moth season of 1924, through Dr. Aulló's interest and kindness, Mr. Dohanian had the use of his laboratories for our investigations.

Rabat, Morocco and Algiers, Algeria, were visited. At the Institut Scientifique Chérifien at Rabat a very interesting conference was held with the Director, Dr. Jacques Liouville, and one of his assistants, Madame P. Schindler, who is interested in applied entomology. Dr. Liouville very earnestly offered his cooperation in our investigations and made arrangements for a trip to the forest of Mamora, near Rabat, with Madame Schindler and Dr. Hartert, Director of the Zoological Museum of Tring, England, who happened to be on an excursion in northern Africa at the time. This is a large cork oak (*Quercus suber* L.) forest, covering several thousand acres and is generally infested by *P. dispar*. The infestation is heavy in many parts and is said to be of about ten years standing. Because of the enormous acreage infested no control methods are being practised. A small shipment of *S. kuvanae* was sent this fall from Melrose Highlands to Dr. Liouville at Rabat for colonization in this infestation.

At Algiers, from an interview with Dr. Paul de Peyerimhoff de Fontenelle, Chief of the Station of Forest Researches of North Africa, a biologist and coleopterist, it was learned that there is a light but general gipsy moth infestation along the northern part of Africa in the oak forest areas from Algiers to Bone, near Tunis. Dr. Peyerimhoff kindly offered to have gipsy moth larvae from this area sent to the States at the proper time.

In Italy only short inspection tours have been made from Genoa, Rome, Naples and Portici, as it was learned from Professor Filippo Silvestri, Director of the Zoological Laboratory of the Royal Superior School of Agriculture at Portici, that the gipsy moth has been very scarce in Italy during the last few years. Professor Silvestri gave me a letter to the Director of the Agricultural School at Caltagirone, Sicily. This school was visited and the director kindly made arrangements for me to inspect a large oak forest, several hours ride by carriage from Caltagirone. In the forest was found a light gipsy moth infestation and an abundance of coccons of *Apanteles melanoscelus* Ratz., one of the gipsy moth larval parasites which has been successfully established in New England.

On our visit to Florence, Dr. Antonio Berlese, Director of the Royal Station of Agricultural Entomology and Professor of Zoology at the Royal Agricultural School, was away but an interview was held with Dr. Giacomo del Guercio, an economic entomologist and Professor Angelo Senna, a coleopterist. Many things of interest were seen at this station, particularly the Rondani collection of Diptera which was in excellent condition.

Germany has been scouted very thoroughly for gipsy moth and brown-tail moth infestations during the last three years. These insects, which have periods of abundance in parts of Germany, are now very scarce. The gipsy moth infestations which have been observed, although very light, are holding their own and possibly slowly increasing. So many entomologists have been interviewed in Germany that it will be possible to mention only a few.

In Berlin Dr. Professor Richard Heymons, custodian of the Zoological Museum of the Royal Institute of Berlin and Professor of Zoology at the Zoological Institute, who is especially interested in noxious insects and their biological control, and Dr. Hans v. Lengerken, teacher of zoology at the Institute, a coleopterist who also is interested in economic entomology, have taken great interest in our work and have aided materially in the thorough scouting of Germany. At the Zoological Museum, Dr. Gunter Enderlein, a dipterist, and Dr. H. Bischoff, a hymenopterist, kindly allowed the valuable collections there to be studied and examined.

Dr. Professor Ludwig Reh, Director of the Noxious Insect Department of the Zoological Museum at Hamburg, Dr. Karl Eckstein, Professor of the Forest Academy at Eberswalde, Dr. Karl Escherich, Professor at the University of Munich, and many other entomologists have been interviewed and have given freely of their time and knowledge to our problems.

In Austria only a few short excursions have been made to the forest near Vienna. At the Natural History Museum in conference with Professor Dr. Hans Rebel, the lepidopterist, and Drs. Anton Handlirsch and Hans Zerny, it was learned that the gipsy moth and brown-tail moth have been scarce for a number of years.

Hungary has been scouted very thoroughly during this period by both Mr. Webber and myself, and a few medium to heavy gipsy moth infestations have been located. Upon arriving in Budapest Prof. Josef Jablonowsky, Director-General in the Staff of Experimental Stations of Agriculture, was consulted and an excursion was made with him to the suburbs of Budapest where there was a light gipsy moth infestation. Prof. Jablonowsky is located in a well-equipped laboratory and has an excellent exhibit of noxious insects showing the damage they cause. The following day the National Hungarian Museum was visited and a conference was held with Dr. Geza de Horvath, Director of the Zoological Section of the Museum and the following of his associates, Drs. Z. von Szilády, a dipterist; A. Schmidt, a lepidopterist; L. Loos, a mycologist, and L. Biro, a microhymenopterist. After this interview Dr.

Horvath kindly consented to allow Mr. Joseph Ujhelyi, an assistant in the Museum, to help in the gipsy moth project. Mr. Ujhelyi proved to be an exceptionally fine assistant and great praise is due him for the part he had in this project. This year at a similar interview at the National Hungarian Museum, Dr. Ernö Csiki, the new Director of the Zoological Section of the Museum, kindly consented to Mr. Ujhelyi's assistance in the work again, although his services were needed at the Museum. Such whole-hearted cooperation is often encountered in foreign countries and has made possible this international work.

Dr. Horvath retired as Director of the Zoological Section of the Museum about a year ago. He was made Honorary Director and now spends practically all of his time on systematic work with the Hemiptera. Dr. Von Szilady is editing a new paper known as "Biologica Hungarica" in which he and his associates publish their papers in the English language.

About 120 miles east of Budapest, at Debreczen, was found a suitable infestation for rearing gipsy moth larvae and their parasites. At the Agricultural University at Debreczen, Prof. Antoni Gulyas offered excellent facilities where the work might be carried on, but less attractive quarters were found in an abandoned blacksmith shop, which was located much nearer the infestation. Dr. Jeno Nagy, a professor at the high school, helped Messrs. Webber and Ujhelyi very often with his general fund of scientific knowledge and his interest in the project.

A large part of Poland has been gone over in search for gipsy moth and brown-tail moth infestations. This work has been greatly facilitated by the office of the Minister of Agriculture, where reports of all injurious forest insects of the country are received. Dr. Stefan Kéler, Entomologist at the State Scientific Agricultural Institute at Bydgoszcz (Bromberg), has been of unusual assistance in this work. He is a forest entomologist and is especially interested in the bark-beetles. Last spring Dr. Kéler and Mr. Webber located a heavy gipsy moth infestation in a small village in the southern part of Poland, near Cracow. The over-forester, Mr. Antoni Czarnecki, offered the use of rooms in his dwelling where the rearing work could be carried on. Mr. Marjan Nunberg, a graduate student of Forestry at the University in Lemberg, was engaged to assist in this work and showed considerable ingenuity.

In Warsaw at the Free University of Poland an interesting meeting was held with Dr. Richard Bledowski, director of the Zoological Laboratory, who is particularly interested in insect parasitology. Near Warsaw, at Skiernicwics, Prof. Sigismond Mokshetsky, Director of the Entomological Section of the Agricultural Experiment Station and

Professor of Entomology at Warsaw University, was visited. Before the war Prof. Mokshetsky was director of the Museum of Natural History at Simferopol in Crimea, where he introduced and built up economic entomology as practised in the United States. During the revolution he lost all of his entomological books, notes and specimens. He had great difficulty in leaving Russia and was able to do so only after having made his identity known to the U. S. Consul by the diploma which was issued to him as a foreign member of this Association.

Dr. Wilhelm C. Knechtel, a specialist on Thysanoptera and Aphididae, is the entomologist of the Government Department of Agriculture of Roumania. He and the Department of Agriculture have assisted the gipsy moth and brown-tail moth investigations in Roumania in all possible ways, and he has given his time without charge to travel over most of Roumania with Mr. Webber and me. There has not been sufficient gipsy moth infestation in Roumania during the last two years to make it practical to inaugurate parasite rearing work.

Bulgaria and Jugoslavia were visited this year for the first time by Mr. Webber and me. Bulgaria has a small but excellent entomological organization. The following members of this staff were consulted: Dr. Ivan Buresch, a lepidopterist, Director of the Natural History Museum of his Majesty the King; Dr. D. Ilcheff, a coleopterist, in charge of the King's Entomological Station, and Dr. P. Tchorbodjieff, a microlepidopterist, Entomologist of the Government Department of Agriculture. His Majesty the King is interested in entomology and has a fine collection of Lepidoptera, many of which were collected by himself or his father.

After a meeting with these entomologists, to whom the nature of our work was explained, a conference was held with the Minister of Agriculture. The minister allowed Dr. Tchorbodjieff to accompany Mr. Webber and me on a trip over most of Bulgaria. A medium gipsy moth infestation was located near a small village situated in the center of the country.

Mr. John Monedjicoff, a resident of Sofia and a graduate of Roberts College of Constantinople, was engaged for the season. An old mill was quickly transformed into an insectary and the collection of gipsy moth larvae and rearing of their parasites commenced. Mr. Monedjicoff overcame many obstacles in the work, where the rearing trays were made of rough lumber, sticky fly paper was used in the absence of tanglefoot, and the grain dust from the tops of the beams of the mill was made into paste to hold the cloth bottoms on the rearing trays.

In Belgrade, Jugoslavia, is a very modern Government Laboratory for the study of Tropical Diseases. Its Director and Chief, Dr. E. Dschunkowsky, a Russian, offered room at the laboratory for our investigations and with the consent of the Minister of Finance, allowed an assistant entomologist, Madame Anna Bragina (Mikrina), to aid in this work. Madame Bragina was a student of Professor Pospelov, Director of the Bureau of Entomology of Russia, and assisted Prof. Mokshetsky in Crimea before the war. She is especially interested in the biological control of insects. During the summer of 1923, among other things, she studied the parasitism of the gipsy moth and the brown-tail moth, and in the winter she prepared a map showing the present gipsy moth infestations in Jugoslavia.

After consulting the map which she had prepared showing the infestations, a trip was made to some of the areas where it appeared most likely that *P. dispar* would be found and a light to medium gipsy moth infestation was located. Arrangements were made for laboratory quarters near the forest and Madame Bragina was employed to carry on the work. Her problem was a difficult one because of the remoteness of the location from supplies and labor. In addition to these handicaps the infestation which was rated in the spring as "light to medium" dwindled as the season advanced to a very light one. However, she was able to obtain over a thousand tachinids which were brought to Melrose.

After the rearing work was completed for the summer of 1924, Mr. Webber visited Brunn and Prague, Czecho-Slovakia. At Brunn Dr. Stepan Soudek, Assistant Professor of Zoology at the Agricultural University, accompanied Mr. Webber on several short excursions to the forests in the vicinity of Brunn. No evidences of *dispar* and *chrysorrhoea* were seen in this area. At the University of Prague, a conference was held with Dr. Julius Komarek, an entomologist and Director of the Institute for the Protection of Forests. He has a forest pest survey made each year and reports that there are *dispar* infestations in the eastern part of Czecho-Slovakia at Kaschau and Munkacs, just south of the Carpathian Mountains. Dr. Komarek is especially interested in the control of forest insects and kindly offered assistance in the gipsy moth and brown-tail moth parasite investigation.

As a result of these investigations, parasite rearing work with gipsy moth larvae has been carried on in five European countries, with one laboratory in Hungary, one in Poland, one in Bulgaria, one in Jugoslavia and two in Spain. From these laboratories there have been sent to Melrose considerably over 100,000 tachinid puparia, over half of

which were *Parasetigena segregata* Rond. Next in order according to the numbers which have been sent are: *Blepharipa scutellata* R. D., *Tachina larvarum* L., (*Zygobothria*) *Sturmia gilva* Hartig, *Lydella nigripes* Fall., *Carcelia gnava* Meig., *Zenillia libatrix* Panz., *Tricholyga grandis* Zett., and *Compsilura concinnata* Meig. Other parasites and predators have been received in small numbers, including *Apanteles fulvipes* Hal., *A. vitripennis* Hal., *A. melanoscelus* Ratz., *Chalcis intermedia* Nees, *Hyposoter* sp., *Hadrocarabus latus* Dejean var. *gougeleti* Reiche and a few *Silpha quadripunctata* L.

I have endeavored to show the area which must be covered in the search for parasites of certain insects. Unfamiliarity with the countries visited and differences of language, manners and customs make us largely dependent upon our fellow scientists living in these countries. They have facilitated the work in many ways and to them much praise is due. They have demonstrated that there are no international boundaries in such work.

PRESIDENT A. F. BURGESS: The next paper is by D. M. DeLong and A. A. Mathewson.

THE INFLUENCE OF TEMPERATURE AND HUMIDITY UPON THE DEVELOPMENT OF *MYZUS HOUGHTONENSIS* TROOP

By D. M. DELONG and A. A. MATHEWSON,
Ohio State University, Columbus, Ohio

ABSTRACT

Lifehistory studies of the Houghton gooseberry aphis in Ohio show a decided variation in the development and length of life cycle of individuals in different generations. Climatic factors seem to affect this development. A high humidity and a low temperature apparently retard development very greatly. High temperature and low humidity seem to accelerate development. Most rapid development occurred when the temperature curve was above the humidity curve.

During the seasons of 1923 and 1924 a study of the Houghton Gooseberry Aphis has been carried on in Ohio to determine the number of seasonal generations, the amount and nature of their damage, experimental work upon control measures and similar problems. A previous report by the authors has dealt with some observations upon this work, but the number of seasonal generations and the necessary time for their development has not been mentioned previously. During the first season there was so much variation in the length of time required for the development of different asexual generations that there was some

doubt in the minds of the authors concerning the possibility of error in the observations made and the number of generations recorded. As a consequence the problem was undertaken during the past season with all possible checks made against error and with a corresponding study of weather conditions which might influence or cause these variations in the length of time necessary for specific generations. The results obtained during the two seasons were very similar and the same number of generations was observed.

During the past season sixteen generations were recorded to the middle of November. The individuals of the last generation lived forty days without reproducing. Although the latter part of the cycle was thus incomplete so far as a record of generations in direct line is concerned, other material under observation showed three additional generations. The greatest time required for development and reproduction exclusive of the last generation which was abnormal, was twenty-eight days, while the shortest time required for other generations was six days. The average time was twelve and one-half days.

Atmospheric conditions studied in connection with the life cycle were temperature and humidity, frequency and amount of precipitation and a record of sky conditions such as cloudy or partly cloudy days. It is rather difficult to place certain conditions or combinations of conditions definitely as the factors which are responsible for or which conclusively limit or determine the length of a generation, but a study of two seasons with corresponding atmospheric records seem to indicate that certain conditions cause rather definite responses, and consequently generalizations or conclusions can be drawn from this study in spite of the fact that in a few instances data might seem to be doubtful.

Rainfall is probably not a factor except as it influences humidity, although usually causing a much higher humidity over a short period of time. So far as general conclusions can be drawn cloudy days or extended cloudy weather in itself, is probably not a factor of any importance.

Temperature at least of a low degree is a limiting and retarding factor in itself (upon the length of an individual generation) but is influenced, and the generation is apparently retarded even more, by a corresponding high humidity. For example in generations thirteen and fifteen the average temperature remained about the same although there was a considerable fluctuation during each period. The temperature reached about the same low mark of 48° in each case. Only ten days were necessary for the completion of the thirteenth generation while sixteen

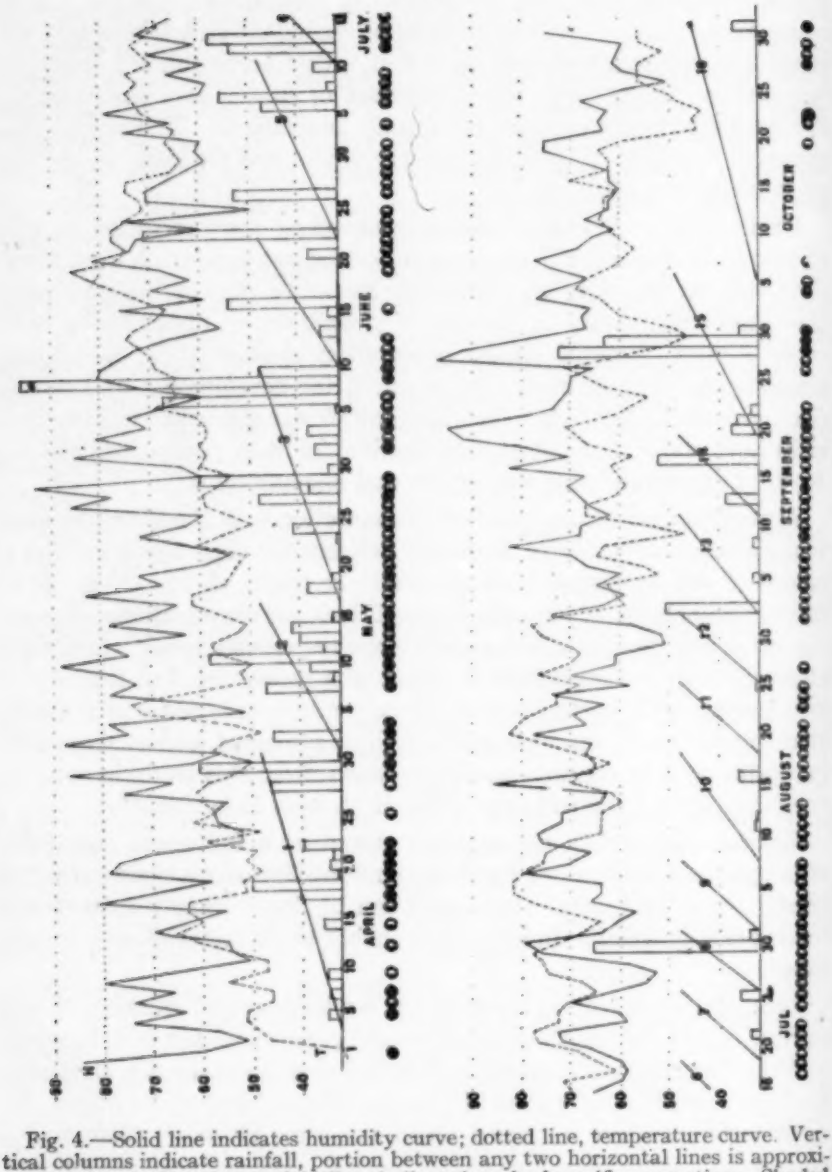

Fig. 4.—Solid line indicates humidity curve; dotted line, temperature curve. Vertical columns indicate rainfall, portion between any two horizontal lines is approximately .3 inch. Slanting straight lines indicate length of specific generations. Shaded circles indicate cloudy days. Partly shaded circles, partly clouded days.

were required for the fifteenth generation. If there is any difference in temperature it would be in favor of generation fifteen, as higher peaks were reached during this period. On the other hand an extremely high humidity was reached twice during this same period, while an average low humidity is recorded for generation thirteen, only one small peak being recorded. Another example might be cited in generation ten where an average medium temperature over a period of about a week with a sharp peak of high humidity, apparently gave a retarding of the cycle. The temperature in this case however, did not drop below 60° and the average was above 65°. Extremely high humidity seems to be very unfavorable for a rapid development especially when a low or medium temperature is prevalent.

Another phase of the problem is also shown by the accompanying diagram. Most rapid development seems to occur when the temperature is high and the humidity relatively low. During the past season the most rapid development occurred when the temperature curve remained above the humidity curve, with very few exceptions. In two specific cases, the seventh and eighth generations, six days were necessary for the development of a generation, while in three specific cases, namely the ninth, eleventh and twelfth generations, seven days were required. The same condition is also found in case of generation six where the temperature curve is higher than the humidity curve. In this instance, too, the time of development is comparatively short but is slightly longer than the others mentioned, apparently because of a somewhat lower average temperature. When the temperature is high, a low humidity seems to accelerate development. This is quite noticeable in generation two, where the temperature made a sudden rise to 73° with a corresponding low humidity of approximately 50. The temperature both before and after this specific instance fluctuated between 50° and 60° and the humidity curve remained for the most part extremely high, this being the only case where a combined high temperature and low humidity occurred during the first three generations. It will be noted that this generation was shortened to sixteen days, while in the preceding and following generations, where the other condition prevailed the time required for development was twenty-eight and twenty-five days respectively.

No attempt has been made to determine absolutely within what limits this condition exists or what combinations are necessary for length of time required for development in specific generations. From the temperature and humidity curves of the season however, as these

are found to occur normally, the changes and fluctuations will be seen to affect the development in general as has been stated. Certain places might be cited for instance, where rapid development will continue when the humidity remains relatively high, provided an extremely high temperature is maintained.

It will be noticed that only mean temperature and humidity records have been brought into this discussion, but the maximums and minimums of both would show this condition even more strikingly. These were not placed upon the chart because of confusion and since the means also represent the general condition and relative values in each case.

Summary and Conclusions

1. Temperature and humidity seem to have a definite effect upon the length of specific generations in the life cycle of *Myzus houghtonensis*.

2. A low temperature, especially below 50°F. seems in itself to be a retarding factor and prolong the time for the development of any specific generation.

3. A high humidity combined with a low temperature is apparently the most important combination of factors for retarding development.

4. The optimum condition for rapid development seems to be a high temperature with a corresponding low or relatively low humidity.

5. The shortest time required for development in every case has been recorded when the temperature curve was higher than the humidity curve.

Mr. A. C. Baker: I would like to ask if there was found any difference in the length of the generation later in the season than earlier in the season. That is, the time was the same, but the number of generations was different. Would there be an entirely different length of life there?

Mr. D. M. DeLong: You mean the different individuals from the same mother?

Mr. A. C. Baker: That is, I want to know whether in the three generations, five or seven generations, providing that the temperature and other conditions were the same, the length of life was the same.

Mr. D. M. DeLong: It seemed to be as nearly as we could tell.

President A. F. Burgess: The next paper is by E. G. Kelly.

AN EXAMPLE OF EXTENSION METHODS AND RESULTS IN KANSAS ENTOMOLOGY

By E. G. KELLY, *Extension Entomologist, K. S. A. C.*

ABSTRACT

A brief summary of the wheat situation in Kansas since 1916 with special reference to Hessian fly, *Phytophaga destructor* Say, control. The methods used successfully in 33 counties are: (1) Stacking the wheat so as to plow the ground in July and finish plowing by the 15th of August, (2) Cultivating the fields with harrow and disc to destroy the volunteer wheat and prepare a good seed bed, (3) Selection of the best seed and (4) Sowing the wheat at the right time, not too early nor too late. Sumner county obtained excellent results with this program in 1916 while McPherson, Marion and adjacent counties were loosing millions of bushels. This object lesson made it relatively easy to secure the adoption of a similar program in the affected areas.

Kansas is recognized the world over as one of the greatest winter wheat growing sections in the United States. This state grows an annual average of more than one-fifth of the winter wheat grown in the United States according to the statistics of the U. S. Department of Agriculture. Recognizing this fact there is little wonder that Kansas suffers a regular devastation by the Hessian fly, *Phytophaga destructor* Say. The first recorded outbreak in 1871 was followed regularly with outbreaks about each five years until 1905. Since that date the insect has been more or less abundant in the state, reaching larger proportion periodically. The devastation in 1908 was about 8 million bushels, in 1912 about 8 million bushels, in 1915 about 10 million bushels and in 1916 about 12 million bushels.

The 1916 outbreak was the last of any consequence until the one of the present year, which according to the report of the Secretary of the Board of Agriculture for Kansas reached approximately 20 million bushels.

The Kansas Experiment Station in cooperation with the United States Bureau of Entomology developed a method for the control of the Hessian fly during the years of 1907 to 1917, which has been used effectively on 20,600 Kansas farms in 33 counties during 1924. The methods of controlling the Hessian fly are (1) Stacking wheat so as to plow the ground in July and finish plowing by the 15th of August, (2) Cultivating the fields with harrow and disc to destroy the volunteer wheat and prepare a good seed bed, (3) Selection of the best seed and (4) Sowing wheat at the right time, not too early nor too late. The fly-free-date as determined in the research of the Hessian fly proved to be the date to sow wheat in order to get good yields only in parts of eastern Kansas, but the Kansas farmers were reluctant to sow their wheat at this late date, or to adopt

the early plowing and tillage part of the program until they had observed several years of demonstrations. The county agents report that the first part of the program is easy to get over, but find it difficult to get the farmers to seed at right time.

The writer was stationed in southern Kansas to do research on the Hessian fly, the station was located at Wellington in Sumner county. This county was one of the banner wheat counties of the state, sowing an annual average of over 300,000 acres. The Hessian fly was more or less plentiful in the wheat every year, doing considerable damage. It was therefore logical that Sumner county be selected as one in which to make an effort to clean up the pest. The outbreak of 1915 in this county paved the way for a successful attempt to put into practice the methods for controlling the Hessian fly, for the farmers were in a receptive mind after seeing the devastation of more than 50,000 acres of their wheat. In cooperation with Prof. Geo. A. Dean, the job of telling Sumner county farmers how the pest could be controlled was undertaken. In June and July farmers were met at cross roads, in the wheat fields and in school houses where the life story of the Hessian fly and the methods of control were demonstrated and explained.

The cooperation of the farmers was as good as could be expected. The wheat stubble, and devasted wheat that was not harvested, was practically all plowed by the middle of August, the harrow was used freely and not much wheat was sown before the fly-free-date. The crop in 1916 was free of Hessian fly and produced one of the best crops that had been grown in the county for several years. While this was true for Sumner county several neighboring counties were having their wheat devastated by the Hessian fly.

Sumner county farmers plowed their wheat lands early in 1917, harrowed them for good seed beds but sowed a little earlier because they believed they had destroyed the Hessian fly. The infestation in the fall was very light and no damage was incurred to the crop.

Early in the spring of 1918 the writer was appointed entomologist of the Extension Division of the Kansas State Agricultural College and therefore changed his office from Wellington to Manhattan. Mr. W. A. Boys was appointed county agent of Sumner county in July 1918 and began his work in that capacity by taking up the work of controlling the Hessian fly in cooperation with the writer. He emphasized the importance of the early plowing, discing and harrowing and furthermore added better seed to the program. The farmers were doing all they could to

grow good wheat and keep the Hessian fly out of it so that there was no need of mentioning seeding dates that fall.

The spring of 1919 a few of the fly could be found but no damage. The farmers got right into plowing early and it seemed that there was no need for further demonstration nor even to mention the pest. The county agent and the writer did not believe we could let the project take care of itself so we kept in touch with the situation at all times. From 1920 to 1923 the situation was not changed, the farmers seemed to be fully informd on growing better wheat. In the fall of 1923 we found 17 wheat fields where the volunteer had not been destroyed, this volunteer was quite heavily infested, running as high as 30%. These fields were located immediately north of the city of Wellington, they were watched very closely to determine infestation in the spring of 1924. The yields were low thus indicating much damage. These fields were plowed and harrowed the first week in July, cultivated several times during the summer and sown to wheat at the safe date this fall. There is no infested wheat in that locality this fall. The farmers of the county were notified in early July that we had found the fly in these fields and advised every one of them to get plowing done early. On August 15 the county agent and the writer determined that about 80% of the wheat stubble land had been plowed and plowing was in full sway at that time. One thing of much interest was to see the threshing machines standing in the barn lots while the farmers were plowing, this was because the wheat had all been stacked. Practically all wheat was sown at the safe date in Sumner county this fall and it is not infested.

In 1916 while Sumner county was free from Hessian fly damage, McPherson, Marion and adjacent counties were losing millions of bushels. Mr. T. H. Parks, Extension Entomologist at that time, the county agents of these two counties and the writer found hundreds of farmers ready to put into practice methods for the control of the Hessian fly, therefore by following the plan which was adopted in Sumner county these farmers were taught how to control the pest. The farmers in these counties have followed these practices since that time and now have the Hessian fly under control. In a survey of the counties this fall it was difficult to find a living specimen.

The state board of agriculture in securing statistics can get very reliable data on the acreage sown to wheat and the bushel yield per acre. The following data is taken from the reports of the secretary of the Kansas Board of Agriculture in substantiation of the statements made in this report. The data for Sumner county is from 1905–17 and 1918–22

inclusive in order to indicate the value of a county agent. If the data had been 1905–15 and 1916–22 the increase would have been greater. The data from Harper, Harvey, Rice and Saline counties is given in order to show the loss sustained where the farm management did not call for control of the Hessian fly. Three of these counties do not have county agents. Harvey county has had a farm bureau and an agent since 1913, but has not included control of Hessian fly in their program until the last two years, and these are not included in the data.

Harper County—1905–1917—sowed 2,042,983 acres, harvested 26,729,553 bushels. This equals 13.08 bushels per acre. 13 year average.

Harper County—1918–1922—sowed 1,001,923 acres, harvested 11,435,824 bushels. This equals 11.41 bushels per acre. 5 year average.

13.08 minus 11.41 equals 1.67 bushels per acre *loss*. 200,384 acres times 1.67 (1.67 equals loss per acre) equals 334,640 bushels annual *loss*.

Sumner County—1905–1917—sowed 2,746,653 acres, harvested 28,187,237 bushels. This equals 10.22 bushels per acre. 13 year average.

Sumner County—1918–1922—sowed 1,517,185 acres, harvested 18,816,046 bushels. This equals 12.33 bushels per acre. 5 year average.

12.33 minus 10.22 equals 2.11 bushels per acre *gain*. 303,537 acres times 2.11 (2.11 equals gain per acre) equals 640,252 bushels annual *gain*.

McPherson County—1905–1916—sowed 2,008,355 acres, harvested 24,744,750 bushels. This equals 12.32 bushels per acre. 12 year average.

McPherson County—1917–1922—sowed 1,277,658 acres, harvested 17,440,295 bushels. This equals 13.73 bushels per acre. 6 year average.

13.73 minus 12.32 equals 1.41 bushels per acre *gain*. 212,943 acres times 1.41 (1.41 equals gain per acre) equals 300,249 bushels annual *gain*.

Marion County—1905–1916—sowed 992,695 acres, harvested 13,637,879 bushels. This equals 13.94 bushels per acre. 12 year average.

Marion County—1917–1922—sowed 757,325 acres, harvested 11,508,550 bushels. This equals 15.20 bushels per acre. 6 year average.

15.20 minus 13.94 equals 1.26 bushels per acre *gain*. 126,221 acres times 1.26 (1.26 equals gain per acre) equals 159,038 bushels annual *gain*.

Harvey County—1905–1916—sowed 1,638,326 acres, harvested 15,635,985 bushels. This equals 15.06 bushels per acre. 12 year average.

Harvey County—1917–1922—sowed 687,794 acres, harvested 9,746,461 bushels. This equals 14.18 bushels per acre. 6 year average.

15.06 minus 14.18 equals .98 bushels per acre *loss*. 114,633 acres times .98 (.98 equals loss per acre) equals 112,340 bushels annual *loss*.

Rice County—1905–1916—sowed 1,864,631 acres, harvested 22,184,606 bushels. This equals 11.89 bushels per acre. 12 year average.

Rice County—1917–1922—sowed 1,194,747 acres, harvested 13,526,076 bushels. This equals 11.31 bushels per acre. 6 year average.

11.89 minus 11.31 equals .58 bushels per acre *loss*. 199,124 acres times .58 (.58 equals loss per acre) equals 115,491 bushels annual *loss*.

Saline County—1905–1916—sowed 1,397,223 acres, harvested 18,378,639 bushels. This equals 13.88 bushels per acre. 12 year average.

Saline County—1917—1922—sowed 860,165 acres, harvested 11,596,949 bushels. This equals 13.48 bushels per acre. 6 year average.

13.88 minus 13.48 equals .40 bushels per acre *loss*. 143,361 acres times .40 (.40 equals loss per acre) equals 45,344 bushels annual *loss*.

The damage by Hessian fly to the 1924 wheat crop ran high in many counties and as indicated above was about 20 million bushels in the state. While this devastation was done to wheat in the state, the counties wherein the farmers practiced the best known methods for the control of the pest the loss was negligible. Had the farmers in the state as a whole practiced the methods recommended by the entomologists, the loss of 20 million bushels would not have occurred, on the other hand there would have been an increase as shown by the data from Sumner, McPherson and Marion counties. If the 12 million acres of Kansas wheat lands had been plowed in July and August, disced and harrowed to prepare the best seed bed and destroy the volunteer, good seed been selected and sown at the right time, there would have been a gain of 20 million bushels in 1924.

PRESIDENT A. F. BURGESS: Inasmuch as there are several papers on the oriental fruit moth, we will defer discussion until the group of papers has been presented. The first paper of this group is by Alvah Peterson.

A BAIT WHICH ATTRACTS THE ORIENTAL PEACH MOTH (*LASPEYRESIA MOLESTA* BUSCK)[1]

By ALVAH PETERSON, *New Brunswick, N. J.*

ABSTRACT

Males and females of the oriental peach moth, *Laspeyresia molesta* Busck, come to molasses-yeast baits. Usually adults come to the baits near sunset each day when the temperature is above 55°F. and when it is not raining. A bait is most attractive for a few days after it is made or replenished with dilute molasses. It may continue to attract adults for 50 days or longer without renewal. By means of traps containing a molasses-yeast bait it is possible to determine by daily observations the presence and relative abundance of the adults in the orchard. One season's observations indicate that males are present in larger numbers than females during the early part of the emergence of each brood, while females occur in larger numbers than males during the later part of each emergence period. This is particularly true of the first and second brood adults.

Since 1917 when the first oriental peach moths were found in New Jersey the author has made numerous field observations and has also

[1]Paper No. 202 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

conducted a number of control experiments for this pest. In March 1924 the author was assigned the problem of making a detailed study of the life history and habits of this insect. This investigation was approached from four angles. First: detailed records (under insectary conditions) were kept on the life history of approximately 5000 individuals representing four broods. Second: similar records were also made for all stages of the insect under caged trees, using three cages for each of the four broods. Third: larvae in infested twigs were collected, counted and measured once (or twice) per week during the entire season from four distantly separated orchards in the state. Fourth: daily collections of moths, males and females, were made from 20 or more bait pans placed in the peach orchard of the New Jersey Agricultural Experiment Stations.

This paper will discuss the results of the last named or fourth phase of the investigations. During 1923 the author became very much interested in baits attractive to the onion maggot (*Hylemyia antiqua* Meig.) and the seed corn maggot (*Hylemyia cilicrura* Rond.)[2] and since then some time has been spent seeking attractive agents for several of our more important insect pests. In August and September 1923 a molasses-yeast bait was placed in the peach orchard at New Brunswick, N. J., and it was observed that males and females of the oriental peach moth came to the bait pans in considerable numbers. This observation resulted in the decision to make a more exhaustive study of attractive agents for the oriental peach moth during 1924. Unfortunately the rush of work early in the season of 1924 made it impossible to make a careful study of attractive baits during the month of May and most of June, consequently this report only treats of the broods of moths following the spring brood. Whether the adults of the spring brood will come to a molasses-yeast bait as readily as those of the following broods is unknown. Another season of study should give us information on this point.

Methods

The following products and chemicals were given one or more trials; molasses, corn syrup, cane sugar, brown sugar, honey, yeast (dry—"Yeast Foam" and wet "Fleischman's"), allyl alcohol, amyl alcohol, methyl alcohol, iso propyl alcohol, butylic alcohol, ethyl alcohol, amyl acetate, aldehyde, benzaldehyde, oil of peach kernels, oil of geranium,

[2]1924. Alvah Peterson: Some Chemicals Attractive to Adults of the Onion Maggot (*Hylemyia antiqua* Meig.) and the Seed Corn Maggot (*Hylemyia cilicrura* Rond.). Jour. Econ. Ent. Vol. 17, p. 87–94.

oil of spearmint, oil of cinnamon, oil of mustard (artificial), oil of lemon, oil of nutmeg, oil of peppermint, oil of wintergreen, oil of anise seed, etc. The odor-producing chemicals employed, as a rule, were placed in water or in sweetened media (corn syrup or molasses, etc.). The amount used, as a rule, was five drops added to approximately 1 pint of media. When yeast was employed the following formula was most frequently followed: 1 quart of sweetened media (molasses etc.), 3 quarts of water and 1 cake of yeast. The baits were placed in containers and traps of various types and sizes and also in different locations in or near peach trees.

The most desirable and efficient container or trap proved to be a small enameled stew pan possessing a wire handle and a small metal extension on the upper margin. The capacity of the pan was approximately 1 quart and measured approximately 3 by 6 inches. The location of the pans or traps in the orchard is important. The largest number of adults were captured in pans placed 3 to 6 feet above ground near the center of peach trees old enough to bear a good crop of peaches. It was also observed that pans which were shaded from the late afternoon sun usually caught more adults than those exposed to bright sunlight. For some unknown reason very few adults were caught in pans placed below, nearby or in the center of one to three-year-old peach trees. All pans were examined and the adults removed at least once a day between 8:00–11:00 A. M. from June 20 to November 1. The recorded dates in the charts are the dates when the adults were collected. When records were made on the precise period of the day when the adults came to the pans, observations were recorded at hourly or more frequent intervals from 3:00 A. M. until 10:00 P. M. In removing the insects from the pans a small round wire sieve was employed.

Discussion

The open pans, partly or completely filled, caught the adults in the following manner. The odor arising from the solution in the pans attracted the adults and when they attempted to come near to the source of the odor they fell or flew directly onto the surface of the liquid and floated. The flight course of an adult is of a zig-zag or up and down type, consequently when the adults came over the attractive liquid they struck the surface with sufficient force to wet some portion of their body, usually the ventral aspect. Once some part of the body was moist the insects were unable to crawl out of the liquid and up the steep sides of the pans or to fly away. In most instances and for a variable period of time after the adults were on the surface of the solution, the

wings were folded along the sides of the body. In striving to get away from the liquid the undersides of the wings became wet and this made the wings spread out. If floating adults were undisturbed by rain or other insects, they remained on the surface of the liquid alive or dead for several days. Some were observed to remain alive for 48 hours or longer.

One of the difficulties associated with this method of catching oriental peach moth is the presence of numerous species of other insects attracted to and present in the pans. This is particularly true when the adults of cutworms and other moths are abundant during June and early in July and again late in the summer. Numerous large insects in the pans make it difficult to ascertain the correct number of small oriental peach moths. The large moths making an effort to get out of the solution are likely to submerge the adults of the oriental peach moths floating on the surface. Course wire screening (¼-inch mesh) was placed over some of the pans. Such screenings kept out the large noctuid moths but it also materially reduced the daily catch of oriental peach moths. Oriental peach moths can pass through ¼-inch mesh wire but very few are caught and held on the surface of the liquid when a wire screen covers the pan.

During the summer of 1923 and 1924 in one or more trials the several odor-producing chemicals (previously listed) were mixed with water or sweetened media (molasses or corn syrup) and placed in the orchard when adults were abundant. So far as observed not a single adult came to the containers or the pans possessing the odor-producing chemicals. Combinations of yeast (dry and wet) with molasses, brown sugar, cane sugar, honey and corn syrup were also tried during 1923. It was observed that adults came in considerable numbers to the pans containing molasses and compressed yeast (Fleischman's). After this attractive bait was discovered early in August, 1923, ten or more pans were filled with a molasses-yeast combination (molasses 1 quart, water 2 or 3 quarts and 1 cake of yeast—Fleischman's) and were kept in the orchard for the remainder of the season of 1923. Occasional examinations (two or three times per week) revealed the presence of a considerable number of males and females of the oriental peach moth during August and September. Adults were caught as late as the last week in September in 1923.

Figures 5 and 6 show the number of adults and the ratio of the sexes captured each day from 20 molasses-yeast bait pans from June 20 to November 1, 1924. The pans were placed in two distinct portions of the peach orchard; ten among four and five year old trees of several varieties and ten among scattered six to eight year old trees with younger

peach trees interplanted. In both locations no pans were closer together than two trees apart (40–50 feet). The total season's catch from the ten pans in the two different sections of the orchard are much alike.

By adding water when needed, the bait pans were kept one-half to two-thirds full. Once a week one-half of the pans in each section of the orchard received approximately one cup of diluted (one-half) molasses. In other words each pan had molasses added to it once every two weeks. The addition of molasses always increased the rate of fermentation. At the outset the baits were dumped and completely renewed. This was found to be unnecessary. The addition of molasses alone to the old bait proved to be satisfactory. Sufficient yeast was present in the old bait to renew active fermentation.

Apparently the gases arising from the bait pans during fermentation possess the agent or agents which attract the adult moths. Just what gas or gases are responsible for this attraction has not been determined. During fermentation a strong sweetened sour odor is present. This same odor continues to exist yet it becomes weaker as the bait ages. As a rule the molasses-yeast bait was most attractive one to four days after the bait mixture was made or after molasses was added to the old baits. The molasses-yeast bait remained attractive to adults for a much longer time than anticipated. In one test, five pans containing a molasses-yeast bait were started July 26 and discontinued September 15, a period of seven weeks. Water only was added to the pans during this period. Adults came to all or some of the pans almost every day during the entire seven weeks. The total daily catch during September was much smaller than early in August. This reduction was due to not only the bait becoming less attractive in the five pans but also to the normal reduction in the number of adults present in the orchard.

Figure 5 shows two distinct peaks in the plotted average line. The points in the average line were obtained by taking an average of the five days about each record. That is, the total adults (males and females) for the recorded date were added to the total for the two previous and following days and the result divided by five. The peaks in the average line undoubtedly represent the maximum abundance of the adults of the first and second brood. The first peak extends from July 15 to July 28, and the second from August 6 to September 1. Comparing these peaks, in respect to the time when they appeared and also in respect to their size and extent, with the life history studies in the insectary there is a close resemblance. In the insectary the only distinct difference is in the first brood of adults. These emerged in greatest number about 7

days earlier than the peak of abundance shown in chart 1. No very distinct period or peak of adult abundance shows up in the average line during September and October in chart 1 for the third-brood adults. Some decided irregularities in the daily catch appear in the chart, particularly during September. These irregularities are undoubtedly due to unfavorable temperature or weather conditions. For example the

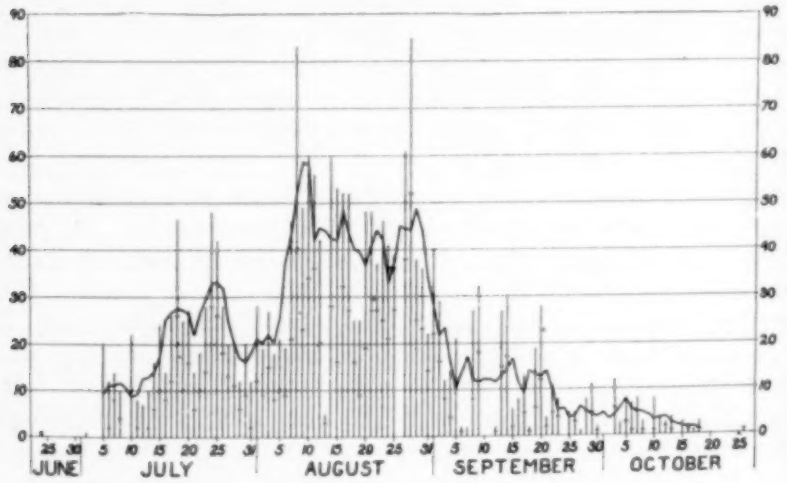

Fig. 5.—Oriental Peach Moth, Graph Showing Daily and Average Catch of Moths.

absence or small catch on September 6 and 7 and again on September 10 and 11 was due to the low temperature (approximately 55°F. or below) which occurred during each previous day when the adults normally should have come to the baits. Throughout the season it was repeatedly observed that the adults were inactive at temperatures below or approximating 55°F. Space will not permit a further discussion on the influence of temperature.

Rain may also interfere with the activity of the adults. For example Figure 5 shows that on August 13 and again on August 26 few, if any, adults were found in the pans. On the two days, previous to each date during the time of the day when the adults normally should have come to the baits, it was raining. This was particularly true for August 26 when a heavy and continuous rain occurred late in the afternoon and evening of August 25.

During July, August and again in September records were made on the time of the day or night that adults came to the bait pans. Frequent

observations during each day revealed the fact that adults came to the baits about sunset. As a rule the first adults for each day were captured fifteen minutes to one hour before the sun crossed the western horizon and they continued to come to the pans until complete darkness existed. The great majority visited the baits during the half-hour of twilight after sunset. In September when the air cooled off rapidly about sunset the

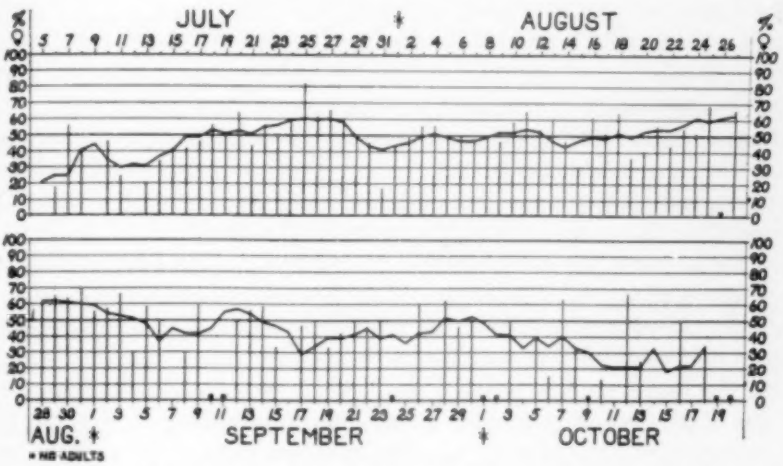

Fig. 6.—Oriental Peach Moth, Graph Showing Daily and Average Percentage of Females in Bait Pans.

largest number of adults appeared just before or at sundown, while in July or August during extremely warm weather few if any adults came to the baits until the sun was below the horizon. Again in warm weather when the temperature at sunrise averaged 65°F. or higher a few adults came to the baits during the twilight period previous to sunrise. So far as observed no adults came to the baits during the sunrise hours when the temperature averaged 65°F. or lower. This means that for the season of 1924 very few mornings existed which were favorable for adults to come to the baits. The total morning catch for any one day during the season never exceeded 25 percent of the total catch for the same entire day and night (twenty-four hours). In a few instances several adults were caught in the pans on warm, cloudy, quiet days when the humidity was high, otherwise no adults ever came to the pans during the middle of the day. So far as a molasses-yeast bait is concerned it may be said that as a rule adults are attracted to such a bait just before or after sunset.

The number of adults captured in any one pan varied from 0 to 16 per day. Individual pans also varied considerably in the total catch for the season. This variation may be due to chance, yet the author is inclined to believe that the location of the tree bearing the pan and the location of the pan in the tree, and possibly other factors are important. This needs further study before definite statements can be made.

Figure 6 shows the percentage of males and females caught each day. The heavy, continuous plotted line is the average percentage of the sexes. This average percentage was obtained by taking into consideration not only the record for a given day but also the number of males and females captured two days previous to and two days following the recorded date. This method of figuring the percentage makes a much smoother curve because it reduces the unusual variation occurring on certain days. On the whole, and for a period of several days, it will be noted that the percentage of males was higher from July 5 to July 17 and again from July 29 to August 15, while the percentage of females was above 50 per cent from July 17 to July 29 and again from (approximately) August 15 to September 4. This variation in the percentage of males and females captured by the baits also agrees in most respects with the brood studies in the insectary. In the life-history studies the males of the first and second broods (at least) appear in greater numbers at the outset of each emergence period than the females and again the females appear in greater numbers after the middle of each emergence period. If this proves to be a constant phenomenon one may ascertain by means of the ratio of the sexes which come to a molasses-yeast bait the approximate period when the first and second brood adults appear in the orchard. In other words when the average percentage of males is greater than the females for several successive days a new brood of adults has made its appearance in the orchard. This assumes that a molasses-yeast bait is equally attractive to males and females. For the first and second brood adults the author believes this is true. Late in September and October a greater percentage of males came to the baits than females. This may be due to the presence of a smaller percentage of females in the orchard or to an unequal attraction response among the sexes at this season of the year. The author believes the former to be true. In most of the insectary jars and in the caged trees it was observed that the males usually lived longer than the females. This in part would help to explain the difference in the ratio of males and females late in the season.

The females captured in the bait pans were dissected and examined for eggs from time to time during the season. In nearly every case the

abdomen of each female was distended and filled with eggs in various stages of development. It is probable that the females came to the baits because they do some feeding before they deposit their eggs.

Molasses-yeast bait pans were also placed in eight to ten year old apple trees in an apple orchard adjacent to the peach orchard where the above observations were made. These pans were started about August 15 and examined daily for the remainder of the season. On some days the average number of adults captured in these pans was as large as the numbers taken from the pans located in the peach orchard.

Insects other than the oriental peach moth came to the molasses-yeast baits. Some of these were males and females of the codling moth. (*Laspeyresia pomonella* Linn.), males and females of the peach tree borer, (*Sanninoidea exitiosa* Say), army worm adults, and numerous species of cutworm adults and other Lepidoptera, many species of Hymenoptera, Diptera, Coleoptera, etc. For those interested in making a collection of insects a molasses-yeast bait might prove to be very useful.

Other interesting facts bearing on the above discussion might be considered if space permitted.

Summary

Males and females of the oriental peach moth are attracted to a molasses-yeast bait when the bait is placed in small enameled pans and suspended on branches of peach trees old enough to bear fruit.

The bait is most attractive one to four days after it is placed out in the orchard. It will continue to be quite attractive for several weeks, 50 days or longer.

The majority of the adults come to the bait pans at sunset or during the twilight hour following sunset. Some may come to the pans early in the morning.

During temperatures approximately 55°F. or below and during heavy rains adults do not come to molasses-yeast bait.

The daily catch record and the average line shown in chart 1 reveal the extent and proportionate abundance of the adults of the first and second broods. The second brood extends over the longest period of time and contains the greatest number of adults. This agrees with the infestation in the field and with the life history data in the insectary.

The average ratio of the sexes in the daily catch of adults may prove to be useful in determining the appearance of new broods in the orchard. So far as observed the males appear in greater numbers during the early part of the emergence period of the first and second broods. The opposite

is also true; that is, females appear in greater numbers toward the end of the emergence period of the first and second broods.

PRESIDENT A. F. BURGESS: The next paper of this group is by T. L. Guyton.

NOTES ON THE LIFE HISTORY AND BEHAVIOR OF THE ORIENTAL FRUIT MOTH IN PENNSYLVANIA DURING THE SEASON OF 1924

By T. L. GUYTON and A. B. CHAMPLAIN, *Pennsylvania Department of Agriculture*

The outstanding observation in the behavior of the Oriental Fruit Moth (*Laspeyresia molesta* Busck) during the season of 1924 was the flight of the moths during the middle of the day. This flight was observed on May 5, 6 and 7. On May 6 the flight was at its height between the hours of ten A. M. to twelve M. The observations were made in the vicinity of Harrisburg in three widely separated orchards. Large numbers of the moths were seen flying about the trees. Numerous pairs were seen mating. Individuals were taken for definite determination. No evidence of egg deposition was noticed at this time. The weather of the three days mentioned was bright and warm for the season of the year. This was followed by two weeks of cloudy weather with heavy rainfall. In this time no active moths were observed. The habit of daylight flying was noted several times thruout the season, although at no later time was the number of moths nearly as many as in the first flight.

The larvae from eggs of the first generation of moths, for the most part, fed in the twigs of peach, although in one orchard where the trees were old and the twig growth slight, many larvae of this generation went into the growing fruit. This infested fruit dropped at the same time the curculio infested fruit dropped. Eggs from the second generation of moths were found on both peach and quince foliage. In the case of quince the eggs were for the most part on the upper surface of the leaves; some eggs were found in the divisions of the calyx of the quince. Third generation larvae were found in quince twigs.

A period was noticed when there was a definite migration of the second brood larvae from the peach twigs to the fruits. This migration was at its height in the vicinity of Harrisburg on July 22. The larvae were about one-half grown at this time.

The rate of infestation in the vicinity of Harrisburg would average about 65% in the ripe peaches. In small quince plantings the fruit was

perfectly protected from the larvae by bagging. The bags were placed on the fruit the first week of July. Tough paper bags were used and were tied in place. Bags which were not tough enough to last thru the season were worthless. Bags placed after July 10 enclosed fruit which contained larvae.

PRESIDENT A. F. BURGESS: The next paper of this group is by L. A. Stearns.

ORCHARD CONTROL WORK OF 1924 AGAINST THE ORIENTAL PEACH MOTH IN SOUTHERN NEW JERSEY[1]

By LOUIS A. STEARNS, *Assistant Entomologist, Agricultural Experiment Station, New Brunswick, New Jersey*

ABSTRACT

Experimental work in the orchard, supported by laboratory tests, demonstrates that spring cultivation (plowing followed by thorough discing) will destroy 100 per cent of the overwintered larvae and pupae of the Oriental Peach Moth, *Laspeyresia molesta* Busck, on the ground about the tree; and, that such cultivation to be most effective must exceed the depth of three inches.

In a spraying and dusting experiment, a combination fungicidal-lead arsenate-nicotine (1–800) spray showed the highest efficiency of any treatment, resulting in an increase in clean fruit amounting to 13.3 per cent. Under average conditions, such a spray should offer a return of approximately twenty cents per bushel over and above the additional cost in spray material.

INTRODUCTION

Periodic fluctuation in the activity of insect species is a commonly observed fact, and in this respect the Oriental Peach Moth is no exception. The growing seasons of 1923 and 1924, each of which witnessed a serious outbreak of the moth, were immediately preceded by an interval of lessened injury and seeming inactivity, but during which, the insect had gradually become distributed, first to the north, and later, far to the south and west of the original area of infestation centering in the District of Columbia. Probably at no time, since 1916, when Quaintance and Wood in their preliminary paper first called attention to "Laspeyresia Molesta, An Important New Insect Enemy of the Peach," has the early interest in this imported fruit pest been more actively revived.

It has been the writer's privilege, for some time in Virginia and during the past summer in New Jersey, to devote more or less attention to the

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[1]Paper No. 204 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

study of this insect. In Virginia, the control of the moth, for the present, seemed to resolve itself into a program of planting varieties which marketing experience had shown subject to least competition and the most profitable, especially since these varieties were comparatively exempt from attack by the moth, and were, moreover, adequately protected by the usual treatments of the existing schedule for peach spraying in that State. Only under severe conditions of infestation did it seem advisable to suggest recourse to additional spraying and cultural methods which, experimentally, had proven worth-while. Such supplemental control measures were naturally given first consideration in attacking the control problem in New Jersey; the results comprise the present paper.

Cultivation

Those who have endeavored to make fall collections of cocooned larvae of the moth have undoubtedly observed how difficult it is to discover these larvae in their wintering quarters even in peach orchards which had shown serious twig and fruit injury during the spring and summer months. Seldom can any larvae be located in the upper portions of the tree; occasionally, some few may be found in the crotches of the larger limbs and in crevices and rolls of the bark and about the margins of exuded gum on the trunk, especially near the surface of the ground. Although the relative numbers of larvae wintering *upon* the tree and *outside* the tree have not been definitely determined, the obvious conclusion must be that the greater majority of larvae secrete themselves in and under trash (leaves, grass and weeds) and in and on mummies on the ground beneath the spread of the tree. Such an inference immediately suggests the value of spring cultivation for the destruction of overwintered larvae and pupae.

Experimental work in this particular was conducted in the Seabrook Company's orchard at Bridgeton, in southern New Jersey, as were, also, the spraying and dusting operations discussed later. One section of this orchard was cultivated and another section, adjacent, was allowed to remain uncultivated. The cultivation consisted, first, of plowing to the depth of about six inches with an ordinary 4- bottom orchard plow about the first of May. This was followed by a thorough discing, cross-discing and diagonal-discing to the depth of from three to four inches, the operation being completed previous to the end of the second week in May. Large cages, twelve feet square, were erected about the base of three trees in the cultivated and three trees in the uncultivated section, two to each of the varieties—Slappey, Elberta and Krummel's October, in order to secure records of the emergence of moths of the spring brood.

These records, as given in Table 1, indicate that thorough spring cultivation destroyed 100% of the overwintered larvae and pupae on the ground about the trees.

TABLE 1.—RESULTS OF EXPERIMENT TO DETERMINE THE VALUE OF SPRING CULTIVATION FOR THE DESTRUCTION OF OVERWINTERED LARVAE AND PUPAE OF THE ORIENTAL PEACH MOTH, SEABROOK ORCHARD, BRIDGETON, NEW JERSEY, 1924

Variety	Emergence of Moths	
	Cultivated Trees	Uncultivated Trees
Slappey	0	4
Elberta	0	13
Krummel	0	60

Supporting laboratory tests with both larvae and pupae were carried on later in the summer at the insectary in New Brunswick. These larvae and pupae were buried in a dry, clayey loam soil at depths varying from one-half inch to six inches. In the case of the larvae, a considerable percentage were able to penetrate to soil level and emerge at the depths of one-half inch and one inch; only a few, however, at the depths of two and three inches; beyond that depth, none. Following emergence in the soil, approximately three-fourths and one-third respectively of the moths from pupae buried at the depths of one-half inch and one inch were able to force their way to the surface. At the depth of two inches, although as high as 70% emerged, none were able to penetrate. The detailed data of these tests, included in Tables 2 and 3 emphasize that spring cultivation to be effective must exceed the depth of three inches.

TABLE 2.—RESULTS OF EXPERIMENT TO DETERMINE THE PERCENTAGES OF ORIENTAL PEACH MOTH EMERGENCE, LARVAE BURIED AT VARYING SOIL DEPTHS, NEW BRUNSWICK, NEW JERSEY, 1924

Depth of Burial in Inches	Percentages of Emergence
½	40
1	32
2	16
3	8
4	0
5	0
6	0
Check	88

25 Larvae Buried at Each Soil Depth Indicated and in Check.

TABLE 3.—RESULTS OF EXPERIMENT TO DETERMINE THE PERCENTAGES OF ORIENTAL PEACH MOTH EMERGENCE AND PENETRATION TO SURFACE, PUPAE BURIED AT VARYING SOIL DEPTHS, NEW BRUNSWICK, NEW JERSEY, 1924

Depth of Burial in Inches	Percentages of Emergence	Percentages of Penetration
½	90	70
1	80	30
2	70	0
Check	100	

10 Pupae Buried at Each Soil Depth Indicated and in Check.

SPRAYING AND DUSTING EXPERIMENT

Altogether, some 57 acres of peaches in their fourth year were used in these operations, this acreage being divided into twelve plots of approximately five acres each and including the varieties—Slappey, Elberta, Fox Seedling and Krummel's October (See Figure 7). The untreated plot in its several sections ran, at right angles with, and approximately thru the center of the treated plots in the case of each of the varieties named. Spray and dust tests were conducted according to both the existing schedule and a tentative schedule, and were arranged in a certain definite sequence.

In the spray tests, of which there were seven, New Jersey "Dry-Mix" sulfur-lime was the fungicide used, Plot 1 receiving this alone. In Plot 2, powdered lead arsenate (1 lb. to 50 gals. water) was combined with the fungicide in the shuck-fall and the following application, while nicotine sulphate 40% at the 1–800 dilution was added in all applications to Plot 3. The strength of nicotine was increased to 1–500 in Plot 4, and, a 1% reground tobacco dust substituted as a source of nicotine in Plot. 5 Plots 6 and 7 duplicate Plots 3 and 4, the applications being made, however, on a 7-day (the tentative schedule) rather than a 14-day (the existing schedule) basis during the interval of the first brood of the insect. In addition, following the last application of the regular spray schedule, the treatments in Plot 7 were continued at 14-day intervals on the late varieties until within two weeks of picking time. In all applications, 250-gallon Friend spray outfits equipped with two leads of hose and single-nozzle guns were employed. Spraying was done from only one side of the row, the amount of spray per tree averaging one gallon.

Plots 8 to 11, inclusive, were dust plots. Plot 8 (dust) duplicated Plot 2 (spray), the 70–10–20 sulfur, lead arsenate, lime dust in the shuck-fall and the following application being superseded by 80–20 sulfur-lime in all succeeding applications. Plot 9 (dust) duplicated Plot 5 (spray), a 1% reground tobacco dust being used. Plots 10 and 11

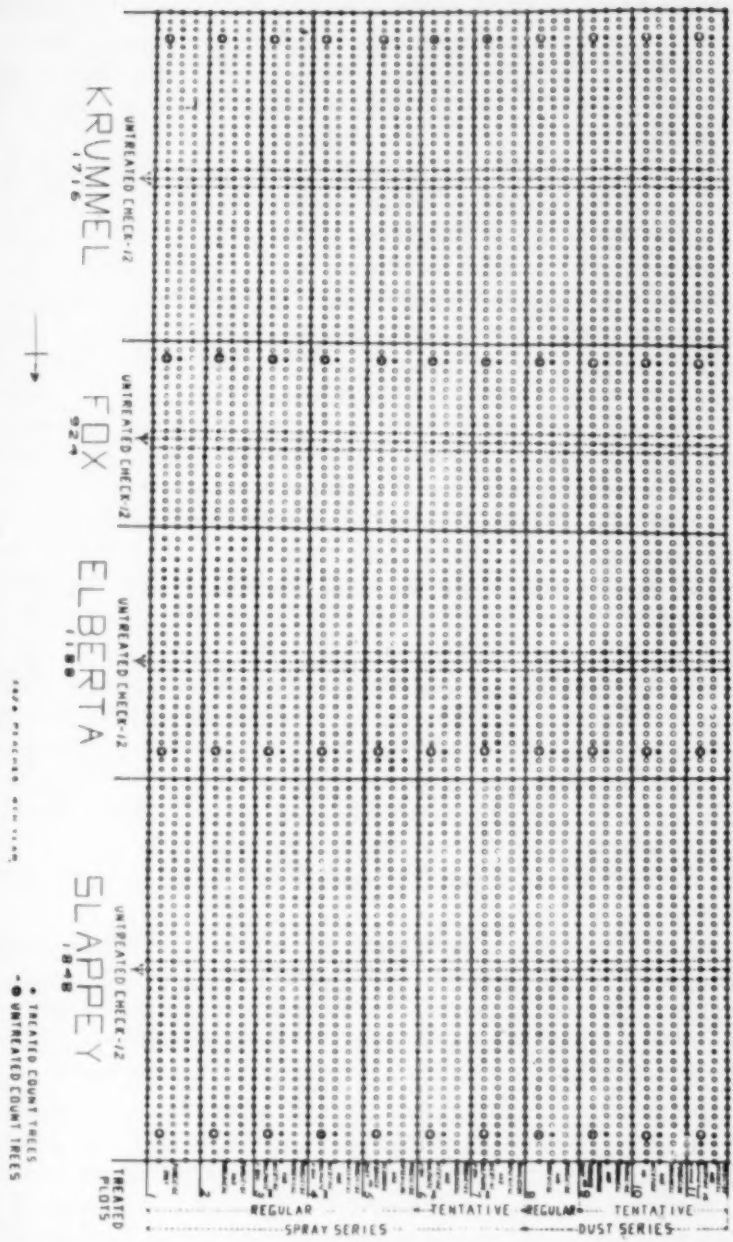

FIGURE 7.—Section of Seabrook Company's orchard, Bridgeton, New Jersey, in which spraying and dusting experiment on control of Oriental Peach Moth was conducted in 1924, showing arrangement and character of plots.

received nicotine treatments in the form of a 3% nicotine dust applied at 14 and 7-day intervals, respectively, and continued on the late varieties until within two weeks of picking time. Niagara dusters were used, and save in one or two instances, dusting was done at night under optimum conditions.

The importance of a factor which should be given due weight in a consideration of the results must be stressed at this time. In view of the fact that the details of the life history of the moth in New Jersey were unknown, a purely mechanical program of application, irrespective of the development of the insect, was followed, treatments being applied at approximately 14 and 7-day intervals following the shuck-fall application depending upon the schedule in question. The applications of the regular schedule were made, therefore, on May 14, May 30, June 13, June 30, July 17 and August 1, the August 1st application being, however, in addition to those usually recommended. In other words, commencing with the shuck-fall application, all varieties received, according to the existing schedule, six instead of five applications, and, according to the tentative schedule, eight instead of six applications. In the light of our present knowledge concerning the local life history of the moth, the inclusion of nicotine in the shuck-fall application was possibly unnecessary.

In order to ascertain as accurately as possible the results of these tests, in addition to general observations during the course of the summer, careful examinations were made to determine the severity of twig injury by the first and second broods of the moth and also the extent of fruit injury at thinning time on 264 "count trees." These trees had been arbitrarily selected in the spring, and were similarly located in the several plots, 24 to each plot, 6 to each variety, half and half treated and untreated.

At picking time, the crop from these 264 trees totaling 52,475 peaches was bought and split to determine the amount of non-visible infestation and injury. This was found to be a variable factor amounting to but .59% for Slappey, 2.7% for Elberta, 15.7% for Fox Seedling and 14.4% for Krummel's October, with an average of 8.3% for the entire crop.

These figures are interestingly correlated with the past season's life history data. The varieties previous to and including Elberta escaped practically all infestation by the fourth brood of the moth, and they were, furthermore, adequately protected by the applications of the existing schedule in the case of the first and second broods. This protection ended, however, with the advent of the third brood to which

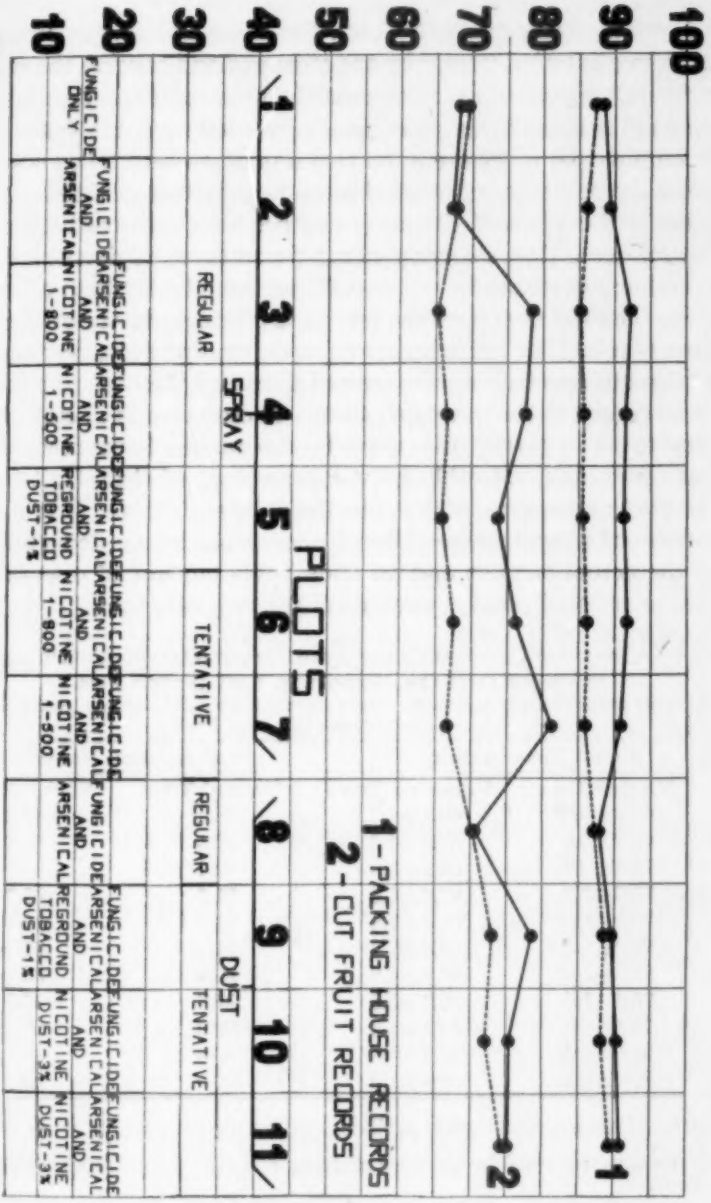

FIGURE 8.—Graphical Summary of Results of Oriental Peach Moth Spraying and Dusting Experiment, Seabrook Orchard, Bridgeton, New Jersey, 1924.
Percentage Worm-free Fruit ———— Treated trees
- - -- - - Untreated Trees

their infestation was largely due. Fox and Krummel were heavily infested, on the other hand, by both the third and fourth broods, the small worms entering largely by the stem end and causing the considerable rise in the percentage of non-visible infestation just noted.

The final results of this experiment presented in Table 4 are graphically summarized in Figure 8, by two sets of curves. The lower set includes the percentages of oriental moth free fruit as determined by the splitting of the fifty-odd thousand peaches from the count trees, while the upper set includes corresponding percentages as determined by a hand-to-hand examination of the cull fruit from better than one million peaches, the total crop from the test plots passing over the grader at the packing house. The full line, in each case, embraces the percentages of oriental moth free fruit on the treated trees and the dash line the same figure in regard to the untreated trees. These two sets of curves follow each other rather closely, the curves for the packing house records showing, however, a considerably greater percentage of clean fruit for both the treated and untreated trees in the different plots. This width or difference (the percentage—8.3—of non-visible injury deducted) indicates the actual amount and an undesirable amount of oriental moth injured or infested peaches packed off as first grade fruit.

TABLE 4.—RESULTS OF ORIENTAL PEACH MOTH SPRAYING AND DUSTING EXPERIMENT, SEABROOK ORCHARD, BRIDGETON, NEW JERSEY, 1924

Plots	Percentages of Clean Fruit			
	Count Tree Records (1)		Packing House Records (2)	
	Treated Trees	Untreated Trees	Treated Trees	Untreated Trees
1	68.3±3.7*	69.9±4.2	88.4	87.2
2	67.2±2.3	67.5±2.6	89.3	86.1
3	78.4±2.2	65.1±1.8	92.1	85.1
4	77.5±1.8	66.6±1.3	91.5	85.7
5	73.9±1.6	65.8±2.4	91.2	85.4
6	76.2±1.9	67.4±2.3	91.7	86.1
7	81.3±1.9	66.8±1.8	90.9	85.8
8	70.7±2.0	70.2±2.6	87.8	87.3
9	78.6±2.7	73.1±1.8	89.9	88.5
10	75.6±1.7	72.1±1.8	90.3	88.1
11	75.1±2.1	74.6±1.9	90.9	89.2

*Formula used in calculation of probable error of the mean:—$E_m = \pm.6745\frac{\sigma}{\sqrt{n}}$

Records obtained:—(1) by splitting all fruits and (2) by hand-to-hand examination of culls.

It is at once apparent from the data included in Table 4 and in Figure 2 that the fungicidal treatment given in Plot 1 and the fungicidal-lead

treatment, applied in Plot 2 as a spray and in Plot 8 as a dust, gave no control of the moth whatsoever. It is also evident that all combination nicotine treatments applied as sprays gave varying degrees of control which were not attained by the same treatments applied as dusts. The spray plots (3, 4, 6 and 7) in which nicotine 1–800 and 1–500 were added to fungicidal-lead treatment, either on the 14-day or 7-day schedule, all gave increases in the amount of Oriental Moth free fruit sufficient to offer a return over and above the additional cost in spray material. The variance in the results for these several plots can be readily explained on the basis of conditions at the times of the different applications which were beyond the control of the experimenter. Plot 3, which received the fungicidal-lead-nicotine (1–800) treatment in six applications (of which the first was possibly unnecessary), gave an increase in clean fruit amounting to 13.3 percent. In this case, no extra labor expense was involved; the treatment consisted simply in adding the nicotine to the usual spray solution. It seems doubtful, however, that its use at either the 1–800 or 1–500 dilutions, according to the tentative schedule, was as beneficial because of the extra cost involved in the two additional applications.

The practical application of this combination spray is dependent upon a variable number of factors of which the severity of the infestation, the cost of the treatment and the prospective yield and value of the crop are most important. It should offer, under average conditions, a return of approximately twenty cents per bushel over and above the additional cost in spray material.

PRESIDENT A. F. BURGESS: The last paper of this group is by E. N. Cory.

LASPEYRESIA MOLESTA BUSCK AS A QUINCE PEST

By ERNEST N. CORY, *College Park, Md.*

ABSTRACT

Records of unusual losses. Overwintering habits and the treatment of containers, which have been found to be one of the principal hibernating quarters of the pest. Heat treatment and paradichlorobenzene have given excellent kill of the hibernating larvae.

The entire crop in one quince orchard of 1200 trees in western Maryland was destroyed this year by a combination of cedar rust and the oriental peach moth. The crop was cut about two-thirds in July by rust and the balance ruined by the larvae of the overwintering brood. While several authors have recorded this pest on quince, its injuries to

this crop appear to have been considered as of secondary importance. Some points in connection with this infestation seem worthy of record.

No evidence of twig feeding has been found in this orchard. The owner did not notice any brown or injured twigs during the season and there must have been an invasion of the orchard after the time of the second brood. Quinces injured by rust to the extent of being mummified were infested by the larvae, probably of the third brood. On a farm in the same district, where peaches and quinces are grown there was twig injury on the peach but no injury to the quince terminals and though the peach crop was injured, the quince crop was a total loss. Other writers have recorded extensive injury to quince terminals.

As a host for the overwintering brood, the quinces, containers and the trees offer many advantages. The fruit matures very late and remains solid enough, so that the larvae may continue to feed until they have completed their growth. Those that complete their growth early, pupate on the trees, while those in the harvested crop form their cocoons between the slats of the baskets and lids or in the corrugated paper pads.

The loose bark and the system of pruning makes it possible for large numbers to form their hibernacula on the trunk and large scaffold limbs. As high as 42 have been taken from one tree, with an average of 13 for 6 trees. Parasites are more effective here, however and predatory arthropods and birds do effective work. *Pediculoides ventricosus*[1] was found in cocoons containing dead larvae.

The containers are the principal seat of hibernacula. One bushel basket and lid yielded 373 larvae. Many of these were completely hidden so that no inspection would locate them. Others were in plain view. The pads likewise offer splendid winter quarters, as high as 175 having been taken from one pad with an average of 135.2 per pad. Practically all larvae spun up with their heads pointing towards the edge of the pad, sometimes 4 being superimposed in one place.

Part of the crop was sent to market, being finally disposed of at a loss. The last picking, 179 baskets, was piled on the barn floor where they remained for several weeks. During that time the larvae constructed cocoons on the fruit, in the containers and even spun up on the floor and walls. Mice fed voraciously on the larvae in the pads in the barn and at College one set of records was lost when mice ate the larvae in a set of fumigated pads left unprotected overnight.

Experiments on the killing of the larvae with heat and paradichlorobenzene have given good results.

[1]Determination by Dr. Ewing, U.S.N.M.

Heat Treatment of Cocooned Larvae in Corrugated Basket Pads

Half pads were placed in an incubator at a constant temperature of 120.2°F. for periods of 1.5, 2, 4, 6, 9.5, and 10 hours. Above 2 hours, 100% kill was obtained at all intervals.

Hours	Live	Dead	Total	Percent dead
1.5	51	31	82	37.8
2	30	63	93	67.7
4	0	49	49	100
6	0	32	32	100
9.5	0	56	56	100
10	0	43	43	100
			355	

Paradichlorobenzene Treatment of Cocooned Larvae in Corrugated Basket Pads

Six side-neck flasks, containing pieces of pads were connected in series with three flasks containing water to cool the air charged with paradichlorobenzene, vaporized in another flask over a water bath at 103°F. A constant flow of air passed through all flasks. The temperature in the fumigating chamber was 80°F.

Hours	Live	Dead from Paradichlorobenzene
4	75	0
7.5	50	0
12	1	48
14	0	28
19	0	50
21.5	0	30
		156

The larvae recorded as dead failed to spin up again after removal from their cocoons though some continued to move feebly for some time. Owing to the reported failures with hydrocyanic acid gas, the results have some significance, though their application to field conditions may be limited.

President A. F. Burgess: Is there discussion on this group of papers?

Mr. W. J. Schoene: I would like to ask Dr. Peterson if he has any idea as to the percentage of the population he was able to secure at his baits—what percentage of the population of the orchard.

Mr. Alvah Peterson: I know of no way in which that information

can be obtained. I can say that from twenty pans kept during the season, the greatest number caught in any one day from the twenty pans was eighty-seven, I believe, or about an average of four to a pan. How many that is of the entire population visiting a given tree, I don't know.

MR. C. L. METCALF: I would just like to say that we ought to suggest to the authors of these papers that there is an opportunity here to set a good example in the use of common names. (Laughter.)

PRESIDENT A. F. BURGESS: I believe the suggestion is in order.

MR. J. J. DAVIS: I would like to go a little further than Professor Metcalf. We call this the Oriental peach moth first and then the Oriental fruit moth, but I believe it should be called Oriental fruit worm. (Laughter.)

PRESIDENT A. F. BURGESS: The next paper on the program is by S. W. Bilsing.

LIFE HISTORY OF PECAN NUT CASE-BEARER *ACROBASIS CARYIVORELLA* ZELL.

By S. W. BILSING, *College Station, Texas*

ABSTRACT

The pecan nut case-bearer is the most important insect that attacks the pecan in Texas. A study of the life history is essential to an approach at control methods. The following article summarizes the main points in the life history which has been studied for six years at several points in the state of Texas. There are either two or four generations of this insect a year which fact probably depends on the food supply. The larva spends the winter in a hibernaculum which it spins on the side of a bud. The first larva emerges from its hibernaculum in March or April and bores into the new growth. The larval and pupal period of the spring brood is passed within this growth. The adult deposits the eggs on tip of the nut or in grooves on the sides. The young larva hollows out the interior of the nuts and pupates within one. The larvae of the second generation also hollows out the nut but the larval stage of the third generation is usually passed within the shuck.

The pecan nut case-bearer is the most destructive insect enemy of the pecan in Texas. It is a native insect and is widely distributed wherever the pecan is indigenous. Its abundance depends upon the extent of the crop the previous year, the number of parasites and the climatic conditions during the months of March, April and May.

The adult is a small gray moth which is from 7 to 9 mm. in length. It always assumes a characteristic attitude when at rest; the wings being held roof-like over the body. It has a wing expanse of from 20 to 22 mm. The moths fly only at night and are very adept at hiding and one seldom or never sees them in the field. When disturbed, they fly with a quick darting flight. The two sexes are very similar in appear-

ance. The male may be distinguished from the female by a black streak on the underside of the forewing near its outer border. The female can be most easily distinguished by the rounded genital opening which is surrounded by a ring of yellowish hairs. Both sexes are very active and on that account are difficult to handle. The length of the life of the adult is very short. Most of them in the experimental cages died in 3 to 5 days.

The eggs are elliptical in shape and just large enough to see without the aid of a lens. When first deposited the eggs are white with a bluish luster. In a few hours reddish spots appear and the eggs are pinkish to reddish in appearance up to the time of hatching. The eggs are usually deposited in the tip of the nut by the moths of the spring brood. Later on when the nuts become larger the eggs are more often deposited in grooves on the sides of the nut, either at the base or near the tip. The eggs hatch in from four to nine days depending upon the temperature. Except in early spring or late fall, the egg hatches in four or five days. The egg is very finely reticulated and when hatched the shell looks much like a miniature gas mantel. The eggs are securely fastened to the nut by a sticky substance and it is difficult to remove one without injuring it.

When first hatched from the egg, the larva is whitish to pinkish in color. Later it becomes an olive gray and just before pupating, it turns to a jade green. Soon after hatching from the egg, the larva begins to wander about in search of a place to hide and to begin feeding. The place where two or three nuts touch and form a dark and protected place is preferred. When the nuts are small, the larvae usually begin feeding on the buds below them. Later on they enter the nuts by cutting out a circular hole at the base. A larva always prefers to work where there are several nuts in a cluster. Before entering a nut, it usually spins a web as a protective screen. This is attached to two or three nuts and protects it from parasites and predaceous enemies. After hollowing out one nut, the larva goes to another and one larva may destroy several nuts.

Many of the larvae of the third brood do not enter the nuts but feed on the interior of the shuck. The larval stage lasts from seventeen to fifty-one days.

Before pupating, the larva spins a flimsy silken cocoon composed of silk and excrement. It is from this fact that the name "pecan nut case-bearer" is applied.

The pupa is very similar to the pupa of many other small moths. It is jade green at first, but later changes to a brown. The pupal stage is

passed in the larval burrow inside the new growth of the branches in the spring, but after the nuts are set, the pupal stage is passed inside the cocoons in the nut. The pupal stage varies from five to twenty-four days. The average time is about nine days in the summer and twelve to fourteen days in the spring.

There are either two or four generations of this insect annually, depending probably on the food supply. The spring brood is derived from the larvae of the third and fourth generation of the previous year and our observations seem to indicate that when there are only two generations that the overwintering larva may be those of the first generation or the first and second generations of the previous year. The fourth generation is not completed until the following spring when the individuals of that generation merge with the larvae of other generations to form the spring brood.

Spring Brood

The spring brood larvae are those which have survived the winter. The larvae spin silken hibernacula or tough overwintering cocoons at the approach of winter or when there is a shortage of the food supply. These hibernacula are usually attached to the side of the buds and closely resemble a bud in color. They are saucer shaped and from one to three mm. in diameter.

At the approach of the first warm days of spring, the larva becomes active and begins to feed on the bud to which the hibernaculum has been attached. At first, they do not go outside of the hibernaculum but feed by cutting a hole on the side attached to the bud. The first larvae begin feeding from the first to the middle of March, depending to a great extent upon the climatic conditions. Later when the new growth appears, they enter the branches or new growth at the juncture of the leaf stem and the main branch. Their point of entrance may always be detected by the frass and excrement which is pushed out at that point. The larva feed in this burrow until they are grown and then spin a cocoon and pupate in this larval burrow. They begin pupating the last part of March or the first part of April. The moths begin emerging about the middle of April and continue to emerge until the middle or latter part of May. The greater number of moths emerged between May 9 and 13. These moths deposit the eggs which have been considered as the first stage of the first generation.

First Generation

The adults or the moths which emerge from the pupa of the Spring Brood begin to lay eggs on the second or third night after they have

emerged. One moth may lay from 50 to 150 eggs. The eggs are usually deposited in the tip of the nut. The eggs hatch in four or five days into a pinkish white larva or worm which feeds for a short time on the buds below the nut. This larva soon turns to an olive green color. After feeding on the buds for a day or two, the larva enters the young nut, when the nut has become about the size of a garden pea, and hollows out the interior of the nut. It goes from one nut to another until it is full grown. Then it turns to the resting stage in the interior of some nut which it has hollowed out. Before pupating, this larva closes the opening, thru which it has entered, with excrement and frass. After stopping up this hole, it spins a flimsy silken cocoon on the interior of the nut and then pupates within. The pupal or resting stage lasts about nine days. From the pupa a moth emerges which again lays eggs on the nuts. The moths of the first brood begin emerging the fore part of June and continue to emerge until the latter part of June and the fore part of July.

Second Generation

The moths of the First generation commence oviposition three or four days after emerging. The eggs which they deposit are to be considered as the beginning of the second generation. Eggs are deposited on the nuts as in the first generation. By this time the nuts have increased in size and the pistil and calyx have dried up. On that account the eggs are usually deposited in grooves at the tip or base of the nut. The eggs hatch in four or five days and the larvae enter the nuts at their bases and hollow out the interior as in the first brood. Due to the fact, that the nuts have increased very much in size by this time, one larva does not destroy as many nuts as does a single larva of the first brood. When the larva becomes full grown, it pupates in a dry nut. Before pupating, the larva spins a silken cocoon and closes up the opening at which it entered with frass. The pupal stage lasts about nine days as in the preceding generation. The first larvae begin to pupate about the middle of July and the last pupate the fore part of August. The moths of this generation begin emerging the last of July and the fore part of August, and continue to emerge until the last of August and the first of September.

Third Generation

The moths of the third brood deposit eggs in the grooves at the tip and base of the nut as did the moths of the second brood, and these eggs are the beginning of the third generation. The eggs hatch in four to six days. By this time, the shell of the nuts has become hard and part of

the larvae feed in the hull or seek a refuge where several nuts touch, and there feed in the enclosure thus formed. Some of the larvae of this brood enter the nuts. Whether or not the larvae enter the nut depends to a great extent on the variety of the nut. Some of the larvae of this generation spin cocoons and go into hibernating quarters while others pupate as in the first brood. This brood overlaps the previous brood. Pupation begins the latter part of August and the fore part of September. The last ones pupate the latter part of September and the first of October. The pupal stage is a little longer than in the previous brood, and usually lasts from nine to twelve days. The moths of this generation emerge from the middle to the latter part of September. The last moths of this brood emerge from the middle to the latter part of October.

Fourth Generation
(Not completed)

The moths of the third brood may not oviposit for several days after emergence if the weather is cool. They deposit eggs on the nuts as in the previous broods and also lay eggs on the buds. If the nuts have already matured, the eggs are deposited on buds. The length of the egg stage varies a great deal depending chiefly on the weather. It may be as short as four days or as long as nine days. After the larvae have hatched, they feed on nuts if they are available. If no nuts are to be found, they feed at the base of buds and leaf stems, after which they spin their winter hibernacula. The last ones to spin hibernacula may not do so until the middle of November.

President A. F. Burgess: The next paper is by T. J. Headlee and on account of the heavy program, he has submitted his paper which will be read by title and will take its place in the Proceedings.

A SMALL CONTRIBUTION TO KNOWLEDGE OF ARSENICAL REQUIREMENTS FOR CONTROL OF CODLING MOTH[1]

By Thomas J. Headlee, *Entomologist, N. J. Agricultural Experiment Station*

Abstract

On the basis of field studies and experiments, under conditions where codling moth, *Carpocapsa pomonella* Linn., normally infests 100% of all the fruit borne by unsprayed trees, it has been found that codling moth infestation, under arsenical treatments, varies, within limits, inversely as the amount of lead arsenate per tree per treatment, inversely as the maintenance of coating during the periods of entry by

[1]Paper No. 209 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

larvae of the first and of the second broods, inversely as the combined factors of lead arsenate and maintenance, and directly as the concentration of infestation.

Introduction

The data on which the conclusions to be set forth in this paper are based were not collected in following out a carefully prepared plan, the object of which was to throw light on the problems of the exact arsenical requirements for destruction of the codling moth. They were gathered in the course of a study, the object of which was to enable apple growers, whose orchards were extremely heavily infested with codling moth, so to modify their practice as to obtain adequate control of that insect; consequently the data submitted are all derived from field experiments, and do not show careful control of all variables save one, which is the mark of carefully and adequately conducted laboratory experimentation.

Orchards from which these data are derived cover an area of about 500 acres, in the form of a solid block of bearing apple trees, the units of which are separated merely by roadways. Twelve years ago in these orchards on the northeasterly exposure, a set of experiments were conducted by the writer in which the codling moth infestation on the check was so small as not to be worth consideration. Beginning five or six years ago, codling moth infestation in these blocks had reached a point where approximately 100% of the unsprayed fruit was destroyed by the codling moth and the spraying practice at that time employed had proved inadequate to bring through, free from codling moth injury, more than 50% of the fruit which set on the trees. Since that time infestation conditions have grown rather worse than better and in most instances, the control obtained has not materially improved but in some cases, the control has improved. Because the blocks from which data will later be submitted are all located in this heavily infested acreage above mentioned, and because the infestation conditions in these blocks have, in every case, been approximately 100% of all the unsprayed fruit, the writer feels that although in a number of cases the results from different years are compared, the figures represent a pretty close approximation of comparable results. All data are taken from count trees well distributed in the middle row of five row blocks and all apples borne by the count trees are taken into consideration. Without doubt, weather conditions in those different years have been different but the only essential difference seems to have been in the distribution of the rain fall, which could effect the results only through removal of coatings applied.

The question of the relative proportion of codling moth larvae entering the blossom end as compared with the proportion entering the other

aspects of the apple is a matter of great practical importance because the answer indicates pretty distinctly the value of the blossom-fall spray from the standpoint of codling moth control. Most studies of codling moth hitherto made agree, in a general way, in finding that more than half of the larvae of the first brood enter the blossom end of the apple. In the season of 1924 a study of this question was made on certain unsprayed trees in the Glassboro district of New Jersey and the data were secured from dropped apples. It seems reasonable that this data is dependable because all apples borne by the trees in question were examined in the course of the season. The following table will serve to show the results from a heavily laden tree.

TABLE NO. 1

Date of examination	No. of fruits examined	Total No. of fruits injured	% of total fruit inj.	No. of fruits blossom end inj.	% of injury blossom end	No. of fruits deep side inj.	% of inj. deep side	No. of fruits shallow side inj.	% of injury shallow side
7/1	461	16	3.4	10	62.5	3	18.7	3	18.7
7/9	303	26	8.5	13	50.0	7	26.8	6	23.0
7/16	103	41	39.8	8	19.5	19	46.3	14	34.1
7/22	106	53	50.0	26	49.0	16	30.1	11	20.7
8/5	189	59	31.2	31	52.5	16	27.1	12	20.3
8/14	324	247	76.2	21	8.5	11	4.4	215	87.0
8/20	100	100	100.	28	28.0	9	9.0	63	63.0
8/27	104	92	88.4	18	19.5	7	7.6	67	72.8
9/3	119	119	100.	34	28.5	9	7.5	76	63.8
9/9	81	81	100.	13	16.0	5	6.1	63	77.7
9/16	105	105	100.	18	17.1	7	6.6	80	76.1
9/23	91	91	100.	12	13.1	5	5.4	74	81.3
10/2	130	130	100.	26	20.0	12	9.2	92	70.7
10/8	111	111	100.	27	24.3	12	10.9	72	64.8
10/23	34	34	100.	6	17.6	6	17.6	22	64.7

These figures support the general findings of other investigators as mentioned above and serve to emphasize the importance of the blossom fall spray.

Leaving out of consideration the factor of timing applications, which was taken care of through the medium of codling moth emergence cages, the first factor to be considered is the arsenical charge. This factor has to do mainly with the arsenical charge per tree per treatment. The figures relating to this factor are set forth in Table No. 2.

TABLE NO. 2—EFFECT OF ARSENICAL CHARGE

Year	No. of applications from blossom fall on	Lbs. of lead arsenate per tree per treatment	Total lbs. lead arsenate per tree per season	No. of apples counted	Blossom end inj. %	Deep side injury %	Shallow side inj. %	Sticker used	Coating maintained
1921	5	0.4	2.0	4280	0.09	10.3	27.6	no	no
1923	6	0.3	1.8	2992	0.03	26.2	51.5	no	no

The figures in this table and the curves in Figure 9 indicate that within the limits tried the amount of codling moth infestation varies inversely as the charge of arsenical used.

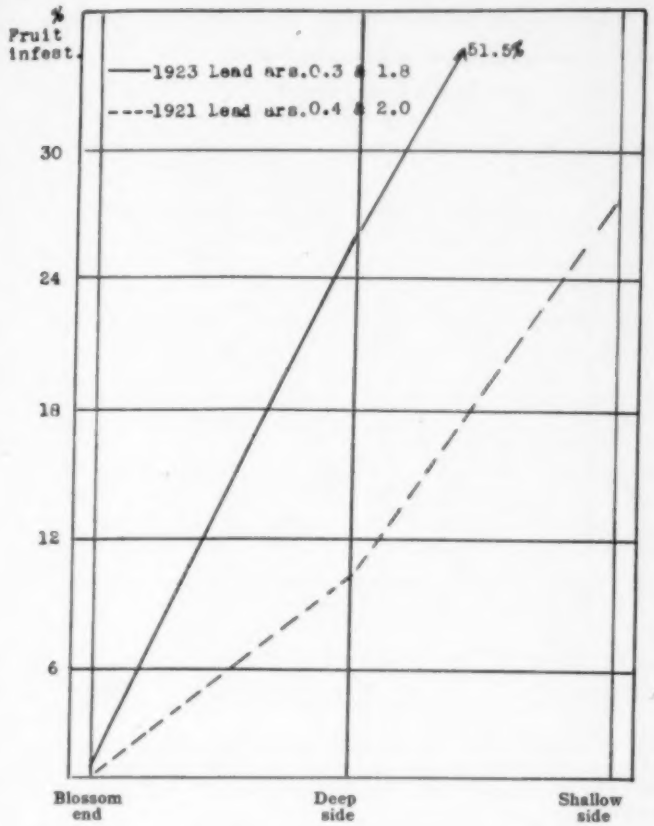

Fig. 9.—Graph showing that percentage of infestation by codling moth under treatment varies, within limits, inversely as the amount of lead arsenate applied per tree per treatment. 0.3 and 0.4 lbs. per tree per treatment; 1.8 and 2.0 lbs. per tree per season.

The second factor is the maintenance of the coating during the periods of fruit entry by the larvae of the first and second broods. The figures relative to this factor are set forth in Table No. 3.

TABLE NO. 3—EFFECT OF MAINTAINING COATING

Year	No. of applications from blossom fall on	Lbs. of lead arsenate per tree per treatment	Total lbs. lead arsenate per tree per season	No. of apples counted	Blossom end inj. %	Deep side injury %	Shallow side inj. %	Sticker used	Coating maintained
1921	5	0.4	2.0	4280	0.09	10.3	27.6	no	no
1921	13	0.4	5.2	3105	0.00	2.4	19.0	no	yes

The figures in this table and the curves in Figure No. 10 indicate that codling moth infestation varies inversely as the maintenance of the coating.

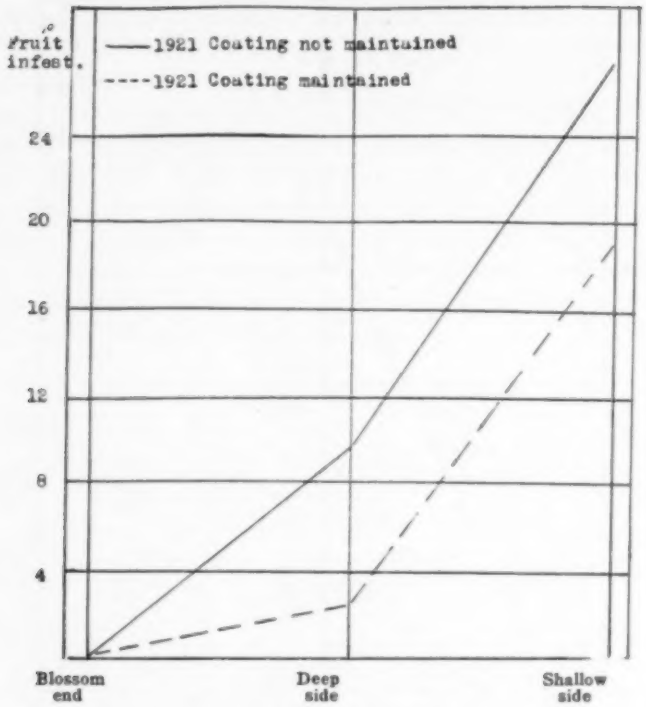

Fig. 10.—Graph showing that codling moth infestation under treatment varies inversely as the maintenance of the arsenical coating during the periods of entry by the larvae of the first and of the second broods.

The figures relative to the relation of codling moth infestation to combined arsenical charge and maintenance of coating are set forth in Table No. 4.

TABLE NO. 4.—EFFECT OF BOTH ARSENICAL CHARGE AND OF MAINTAINING COATING

Year	No. of applications from blossom fall on	Lbs. of lead arsenate per tree per treatment	Total lbs. lead arsenate per tree per season	No. of apples counted	Blossom end inj. %	Deep side injury %	Shallow side inj. %	Sticker used	Coating maintained
1923	6	0.3	1.8	2719	1.7	17.3	48.0	Yes 1.5 lbs. to 100 gals.	No
1924	12	0.4	4.8	9558	0.77	0.18	23.6	Yes 3.0 lbs. to 100 gals.	Yes

The figures set forth in the above table, and the curves in Figure 11 indicate that codling moth infestation varies inversely as the combined factors of arsenical charge and maintenance of coating.

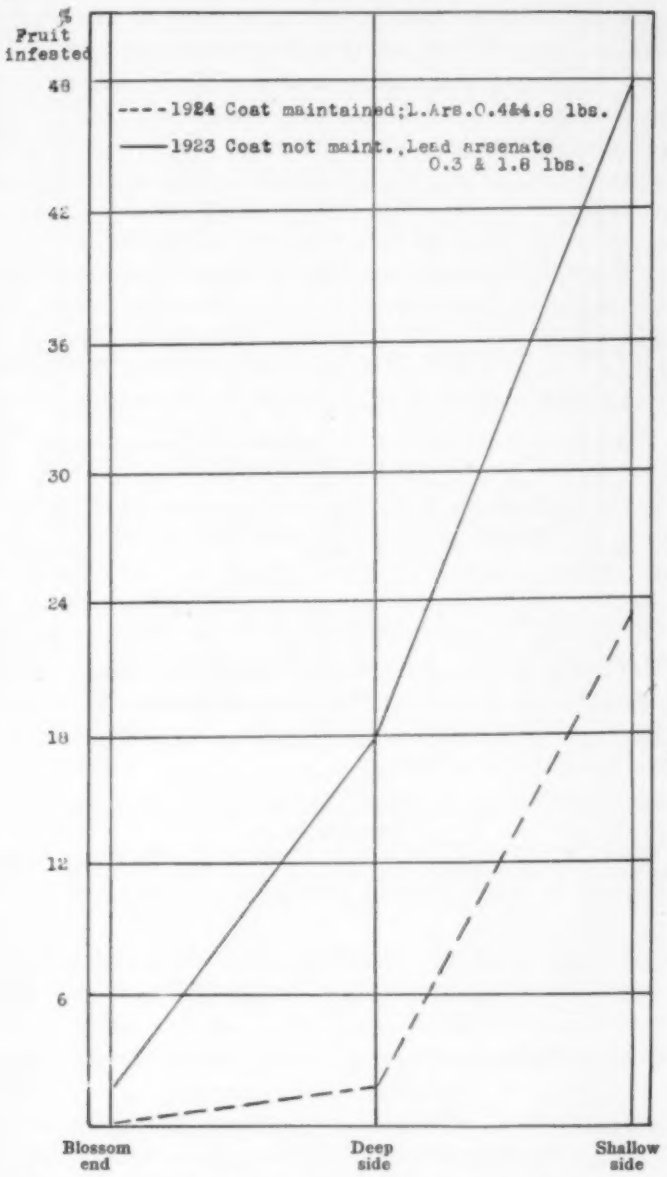

Fig. 11.—Graph showing that codling moth infestation under treatment varies inversely as the combined factors of amount of arsenical per tree per treatment and maintenance of coating during periods of entry by larvae of the first and of the second broods. 0.4 and 0.3 lbs. per tree per treatment; 4.8 and 1.8 lbs. per tree per season.

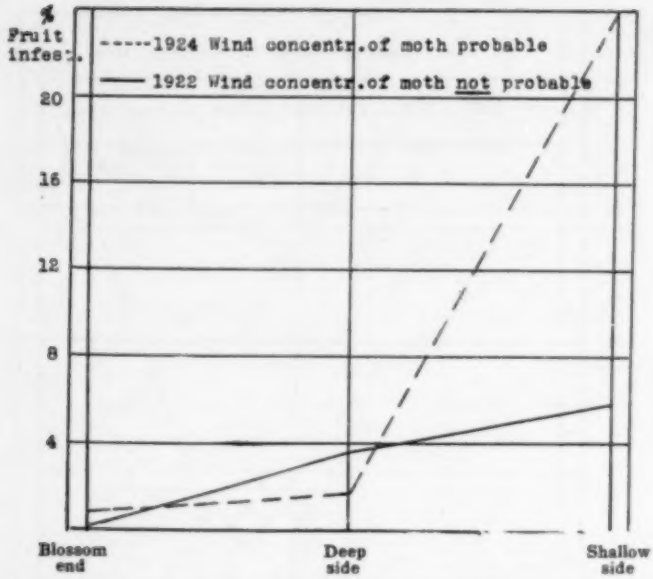

Fig. 12.—Graph indicating that infestation by codling moth under treatment varies as wind concentration of the infestation.

The third factor is codling moth concentration as occasioned by prevailing winds but the facts recorded would doubtless apply to any heavy concentration, regardless of how it was caused. The figures relating to this factor are set forth in Table No. 5.

TABLE No. 5.—RELATION OF CODLING MOTH INFESTATION TO WIND CONCENTRATION

Year	No. of applications from blossom fall on	Lbs. of lead arsenate per tree per treatment	Total lbs. lead arsenate per tree per season	No. of apples counted	Blossom end inj. %	Deep side worm inj. %	Shallow side worm inj. %	Sticker used Lbs. to 100 gals	Coating maintained
1922	5	0.4	2.0	3961	0.09	3.6	5.8	Yes 1.5	Yes
1924	12	0.4	4.8	9558	0.77	0.18	23.6	Yes 3.0	Yes

The figures in this table, together with the curves in Figure 12 indicate that the percentage of infestation under treatment varies as the degree of wind concentration. It is entirely probable that concentration, regardless of the cause thereof, will exhibit the same relationship to fruit infestation under treatment.

It is to be regretted that the writer does not have absolute figures upon actual moth concentration and is compelled to depend, for his data, upon close field observations covering a period of about four years

in this particular orchard area. It has been his experience that in the southwesterly portions of this orchard, where no orchards to the southwest stand within a mile of them, the infestation is materially lighter than it is in the northeasterly portions, as indicated by the presence of moths fluttering in the evening about the trees and particularly by the increased injury in the northeasterly portions as compared with the decreased injury in the southwesterly exposures. The prevailing winds in this section, during the period of codling moth activity, are southwesterly. The block worked in 1922 was located on the southwesterly exposure, while the block worked in 1924 was located on the northeasterly exposure of the same orchard block. The spray applications were even more thorough and complete in 1924 than they were in 1922, yet a glance at either the tables or the figures indicate that they were not as effective.

General Discussion

Assuming the correctness and comparability of the timing of the applications for side worm entrance of the first and second broods (this timing was made through the medium of codling moth emergence cages), it seems that there are three main factors underlying the control of codling moth by means of arsenical treatments: (1) The amount of arsenic applied per tree per treatment; (2) the constancy with which this coating is maintained during the periods of entry; (3) concentration of codling moth, either through the agency of prevailing winds, or through other natural increase.

Without doubt, the most powerful factor is concentration, which the writer believes can be overcome through the cumulative effect of the employment of arsenicals. Of course, he recognizes that the concentration in this orchard area is obviously not equal to the concentration in some of the western areas. For instance, the maximum number of overwintering codling moth found on the trunk of a single, large apple tree in this area, even adjacent to the packing houses, has never reached quite two hundred. He has been told that in some places in the west the number on a single tree has reached almost two thousand, or ten times as many.

The second factor in importance, he believes, is the arsenical charge in relation to the size of the tree. In dealing with apple trees eighteen to twenty feet high and twenty-five to thirty feet across he has found four-tenths of a pound of lead arsenate in ten gallons of spray per tree per treatment to give excellent results. It is possible, of course, that larger amounts might do better but they do not seem to have done so.

The third factor is the maintenance of the coating thus established during the period of entry by larvae of the first and larvae of the second broods. This is a factor, the importance of which is not usually realized because in comparatively light infestations of codling moth, say when the check trees do not exceed fifty per cent, a single heavy coating may be quite adequate for the control of the entering larvae of a single brood, be it first or second. Under such conditions, the factor of timing seems to meet the situation and, consequently, most of the codling moth investigators have borne heavily upon that phase of the question, having found it sufficient to meet the situation. Under conditions of heavy infestation, such as exists in certain orchards of the Glassboro district, timing does not seem to meet the problem, apparently because the period of entry of a single brood, whether first or second, is too long for one treatment to remain active, except when, through lack of rainfall, the coat remains intact over a very unusually long period.

SUMMARY

Under codling moth infestation conditions, where approximately 100% of all the fruit borne by unsprayed apple trees is infested by codling moth, and the time factor of the sprays for the entering larvae of the first and second broods is adequately taken care of, codling moth infestation under treatment varies within limits inversely as the amount of arsenical applied per tree per treatment, inversely as the thoroughness with which the coating is maintained during the periods of entry, and directly as the concentration developed through the agency of wind or natural increase.

PRESIDENT A. F. BURGESS: The next paper is by P. J. Parrott.

THE EFFICIENCY OF VARIOUS SPRAY AND DUST MIXTURES IN CONTROLLING THE ROSY APHIS

By P. J. PARROTT and HUGH GLASGOW, *Geneva, N. Y.*

ABSTRACT

Lubricating oil emulsion, wettable sulfur with nicotine sulfate, and nicotine dust (2 per cent nicotine) controlled the rosy aphis (*Anuraphis roseus*), altho none of these preparations were quite so effective as lime-sulfur with nicotine sulfate, which is the standard treatment. The spray mixtures should be applied preferably during the delayed-dormant period, while dust mixtures containing a 2 per cent nicotine will probably give best results when used for the pre-pink treatment. Dust and spray mixtures applied during the pink and calyx periods gave in most instances inferior control.

To combat the rosy aphis, the apple growers of the State of New York depend almost exclusively on spraying with lime-sulfur solution at a

dilution of one part to eight, ten or fifteen parts of water, to each one hundred gallons of which there is added from three-fourths to one pint of nicotine sulfate (40 per cent nicotine). In the approved spraying schedule it is recommended that the treatment should be made when the tips of the leaves of the more advanced blossom buds are projecting as much as one-fourth to half an inch. If care is exercised to wet thoroly the ends of the buds the susceptibility of an important fruit pest to treatment can hardly be more strikingly demonstrated.

The introduction of lubricating oil emulsion and nicotine dusts as commercial commodities suggested two problems for investigation, which were calculated to shed light relative to the efficiency of existing control measures or suggest desirable modifications of present spray methods: (1) The aphicidal properties of these new insecticides in comparison with standard spraying practices; and (2), the susceptibility of the rosy aphis to treatment at other periods than when the buds are opening.

Description of Materials and Time of Treatment

Nicotine sulfate (40 per cent nicotine) was used at the rate of 1 pint to 100 gallons of lime-sulfur. In the test with this combination, there were three plats which were sprayed once only as follows: Plat 1, a delayed-dormant application, using lime-sulfur at the rate of 1–15 as the carrier of nicotine sulfate; Plat 2, a pink application with lime-sulfur at a dilution of 1–40; and Plat 3, a calyx application, the spray being of the same composition as that used in Plat 2.

The dust was composed of 90 pounds of superfine dusting sulfur and 10 pounds of lead arsenate carrying 2 per cent nicotine. One application only was made to the different plats which were treated at the following periods respectively: Plat 1, delayed-dormant application; Plat 2, early pink; Plat 3, pink; and Plat 4, late pink.

The red engine oil emulsion, 3 gallons to 97 gallons of water, was applied at two periods—delayed-dormant and pink, while the "dry-mix" or wettable-sulfur spray (sulfur 16 pounds, lime hydrate 8 pounds, calcium caseinate 1 pound, and nicotine sulfate 1 pint to 100 gallons of water) was used as a delayed-dormant application and as a pink application. The different materials were applied to 25-year-old Greening trees, the spray mixtures at the rate of 12 to 15 gallons per tree, and the dust mixtures at about 5 pounds per tree.

The data relative to the effectiveness of the various materials used at different periods are given in Tables 1 and 2.

TABLE 1.—THE EFFICIENCY OF VARIOUS DUST AND SPRAY MIXTURES IN CONTROLLING THE ROSY APHIS IN RELATION TO TIME OF TREATMENT

Time of making application	Number of trees counted	Average number of fruits per tree	Average number of aphis apples per tree	Percentage apples injured by rosy aphis
Lime-sulfur with nicotine sulfate				
Delayed dormant (Lime-sulfur 1–15)	17	1211	2.5	0.21
Pink (Lime-sulfur 1–40)	17	1037	87	8.39
Calyx (Lime-sulfur 1–40)	5	1340	593	44.25
Check	5	1967	1076	54.70
Sulfur-lead-arsenate dust with 2 per cent nicotine				
Delayed dormant	10	1375	362	26.32
Early pink	10	1021	24	2.35
Pink	9	623	268	43.01
Late pink	8	1743	587	33.67
Check	5	1967	1076	54.70
Lubricating oil emulsion				
Delayed dormant	10	684	45	6.57
Pink	7	3097	1342	43.33
Check	5	1967	1076	54.70
"Dry Mix" or "Wettable Sulfur" with nicotine sulfate				
Delayed dormant	9	644	22	3.41
Pink	8	309	109	35.27
Check	5	1967	1076	54.70

TABLE 2.—THE MAXIMUM INSECTICIDAL EFFICIENCY SECURED WITH DUST AND SPRAY MIXTURES APPLIED UNDER OPTIMUM CONDITIONS

Treatment	Number of trees in plat	Time of making application	Average number of fruits per tree	Average number of aphis apples per tree	Percentage apples injured by rosy aphis
Lime-sulfur 1–15 with nicotine sulfate 1 pint to 100 gallons	17	Delayed dormant	1211	2.5	0.21
"Wettable sulfur" with nicotine sulfate 1 pint to 100 gallons	9	Delayed dormant	644	22	3.41
Lubricating oil emulsion, 3 gallons to 97 gallons water	10	Delayed dormant	684	45	6.57
Dust, 90–10 sulfur-lead-arsenate (2 per cent nicotine)	10	Early pink	1021	24	2.35
Check	5	No treatment	1967	1076	54.70

Summary and Conclusions

Of the different materials tested lime-sulfur with nicotine sulfate proved by far the most consistently effective. Under this treatment there was an average of less than 3 apples per tree for the entire plat of 17 trees, the yields of which averaged 1200 fruits each.

The "dry-mix" or "wettable sulfur" spray containing nicotine sulfate was appreciably and consistently less efficient against the rosy aphis than lime-sulfur with nicotine sulfate.

The lubricating oil emulsion, while giving good commercial control, was inferior to lime-sulfur or even the "dry-mix" spray, altho the difference in insecticidal efficiency is not striking. Since the cost of material is relatively small, the oil emulsions of this type appear to have a distinct field of usefulness, especially if the treatment is aimed at the joint control of San Jose scale and aphids, and no provision needs to be made for plant diseases or other species of insects.

The sulfur-lead-arsenate dust (2 per cent nicotine) proved efficient when applied at the proper time. The period for effective treatment with dust mixtures of this character appears, however, to be considerably shorter than in the case of the foregoing spray preparations; and for this reason, without taking also into consideration the essential conditions for satisfactory dusting, high temperatures, little or no air currents, freedom of foliage from moisture, etc., it seems not unreasonable to assume that failure to control the rosy aphis as a result of faulty timing will probably occur more often than when spray mixtures are employed.

For all spray combinations tested the delayed dormant period, viz,. when the tips of the leaves of the more advanced blossom buds are projecting as much as one-fourth to half an inch, is without question the proper time to make applications for the control of the rosy aphis as is clearly indicated in Tables 1 and 2. The results of the experiments also suggest that the time for effective spraying may be prolonged somewhat over a period approaching the pink stage provided the young leaves infested with the insects have not become too tightly curled. If treatment is deferred until the blossom clusters are in the true "pink" stage the chances for combating the pest effectively are decidedly less favorable for the reason that by this time the affected leaves may be so badly twisted and curled, making it almost impossible to reach many of the aphids either with dust or spray mixtures. Even with the spray mixtures that are effective in the delayed dormant application the degree of control secured with treatments when blossoms were in the pink stage has

been much inferior to that secured by applications earlier in the season. The less effective combinations of spray materials are hopelessly inadequate at this time and it is a question whether the amount of protection secured in such cases would warrant the expense of treatment. When blossom clusters were in the "calyx" stage, even the most effective sprays containing nicotine, applied with great thoroness, have had little or no value in reducing the amount of injury by the rosy aphis, and from the results of our experiments to date there is little ground for recommending fruitgrowers to spray at this period.

Where dust mixtures containing the higher percentages of nicotine sulfate were used, the delayed-dormant applications have never given a fair measure of control. If treatment is deferred until the pink of the blossoms is beginning to show but before the true "pink" stage is reached, a striking reduction in the amount of aphis-injured apples has been secured. Applications of the dust mixtures during the "pink" period do not appear to be any more effective than the sprays containing nicotine, and this also holds true for the calyx application.

MR. J. J. DAVIS: Is that a two per cent oil emulsion?

MR. P. J. PARROTT: Yes, that is what it would be; that is, three gallons of the Government formula to ninety-seven gallons of water.

MR. W. P. FLINT: I would like to ask what oil was used.

MR. P. J. PARROTT: Red Engine Oil in this case. Of course, this is only one of a series of experiments. There wasn't time to give the others here.

MR. ALVAH PETERSON: I would like to ask how much time there is between the early pink and the pink stage.

MR. P. J. PARROTT: That varies according to seasonal conditions, and we don't always have the same time every year, but I should say between five to ten days on an average; that is, in our state.

MR. W. W. YOTHERS: I would like to ask Mr. Parrott if he used the Bordeaux oil emulsion.

MR. P. J. PARROTT: Yes, although we did not get quite as good results as we did with lubricating oil emulsion.

PRESIDENT A. F. BURGESS: The next paper is by F. R. Cole.

THE NATURAL ENEMIES OF THE CITRUS APHID, *APHIS SPIRAECOLA* (PATCH)

By F. R. COLE, *U. S. Bureau of Entomology*

ABSTRACT

This is a preliminary report on the natural enemies of *Aphis spiraecola* in Florida. The citrus area of the state was injured by the aphid to the extent of about four million dollars during 1924. No true parasites were observed by the writer, but several predaceous insects are of some value in checking the aphid. In colonies on the native host plant, *Spiraea* spp., only two small predators were noted, a coccinellid beetle and an agromyzid fly.

Citrus growers in Florida have witnessed an unusual insect epidemic during the past year. During the winter of 1923 many growers reported an unusual outbreak of aphids on orange trees, and with the coming of the spring, the new pest loomed up as a real danger to the industry. Two species of aphids, *Aphis gossypii* and *Toxoptera aurantii*, are found in practically all citrus growing regions, and these have never been of any great importance.

This new pest is a little known species that is found in all parts of the United States on plants of the genus *Spiraea*. Recent studies, however, indicate that we may be dealing with a form of the well known green apple aphid. In 1924, the aphid declined in numbers until it was reported "all gone" from many localities in September. But the new "flush" of growth in October brought out another flare up of the pest, and it will be present in the spring again. In concluding these introductory remarks it may be of interest to note that the estimated damage to citrus by this aphid in 1924 is about four million dollars.

The natural enemies of this citrus aphid are of more than usual interest because, so far as we have observed, there are few true parasites. Practically all control of the aphid by insect enemies during 1924 was accomplished by predators. The predators of importance belong to three orders of insects: the Neuroptera, Coleoptera, and Diptera. The usual enemies of aphids are found in Florida, and the coccinellid beetles are probably of most importance, closely followed by the syrphid flies, the lace wing flies being a minor factor in control.

NEUROPTERA

The larvae of the green lace wing flies, (*Chrysopa spp.*) are known as "trash bugs," and they are abundant on citrus in Florida, where they are more or less general feeders. When aphids are present the neuropterous larvae feed on them. The white, long-stalked eggs are often seen on orange leaves. When the larvae hatch from these eggs they stay

on their stalked platforms for two hours or more, after which time they crawl down and become very active in their search for food, usually starting out by cutting down their empty domicile and carrying it away as a beginning of the trash pile that soon accumulates on their back. Aphid skins, their own cast skins, and various other trophies soon cover the small larva. The instars are short, the first two being about three days each, and the pupal period is about ten days.

COLEOPTERA

The Coccinellid beetle most frequently seen around colonies of the citrus aphid is a melanic form of *Olla oculata* Say, known as *sobrina* Casey. The species is easily confused with the Twice-stabbed Lady-beetle, *Chilocorus bivulnerus*, the characters for separation being obscure.

Beginning in October the well known Twice-stabbed Lady beetle was found in increasing numbers in the vicinity of Orlando. This jet black species is 4 to 5 millimeters in length and does not have the anterior margin of the pronotum yellowish white as in *Olla oculata sobrina*. The sides of the pronotum are finely pilose and the venter of the abdomen red on the posterior portion. There is a spur-like projection on the outer basal third of the front tibia. The wing covers are finely punctured. The small clusters of bright yellow, long-oval shaped eggs of this beetle are often seen among the aphids. The first stage larva is small, but grows rapidly and moults in about four days. The grown larva attaches itself to a dead twig and pupates, several individuals often being seen in a small space. This species is active most of the year in Florida and because it is not dependent on the citrus aphids for food it is of considerable economic importance.

Hippodamia convergens Guerin is not uncommon in some parts of Florida and has been observed eating the citrus aphid. *Cycloneda sanguinea* (Linn.), commonly known as the Blood-red Ladybird beetle, is one of the predaceous enemies of the new aphid, but we have not seen it in any great numbers.

There are undoubtedly several species of *Scymnus* in Florida that feed on aphids. The species commonly taken in the vicinity of Orlando was determined by Dr. Schwarz as *Scymnus cervicalis* Muls. The adult beetles eat a great many aphids and are ably supported by their incrusted larvae, which resemble mealy bugs. Beetles in captivity ate about 12 aphids a day per individual and exhibited some differences in their manner of attack. The larvae destroy almost as many aphids as

adults, seizing their prey by one leg and draining the body juices of the victim through this appendage.

DIPTERA

SYRPHIDAE. In the vicinity of Orlando, Florida, the citrus aphid is preyed upon by two species of syrphid flies, both belonging to the genus *Baccha*. Many years ago Hubbard studied the enemies of aphids and described three species of *Baccha*. We have found *Baccha clavata* Walker quite common in all infested territory, and have taken a few specimens of *Baccha lugens* Loew. The slender, oval, white eggs of these two predators are apparently indistinguishable, and are often seen in aphid colonies; these eggs hatch in about forty-eight hours. A mature larva will devour 20 to 30 aphids per day if aphids are abundant.

In studying these flies we perceive an interesting provision of nature. The aphid is short lived and lives only on the newest growth of the orange. In a week or ten days the "flush" becomes too hard for the aphid and winged forms develop and fly to fresher growth. The slow moving, sightless maggot cannot follow its host. The usual larval period of seven days may of necessity be shortened to five days in order to save the insect. By the time the new growth has hardened the syrphid larva has pupated in the curled leaf.

The larvae of these flies feed in the usual manner and are undoubtedly of considerable value in aphid control. The larva attaches itself to a leaf when ready to pupate, a sticky secretion gluing it to the surface. The body walls shorten and swell out into a characteristically shaped puparium.

The larva of *Baccha clavata* is more or less cylindrical in general shape, but flattened, the body outline irregular and covered with short, stiff hairs. The body color is normally pale green, with white markings and a yellowish brown median dorsal line. The puparium is more or less fig-shaped, the smaller end slightly curved and fastened to the leaf surface. The color is dull yellow to dark buff, marked with cross-shaped dark spots on the dorsum. The larval spines become very small and stubble-like. The adult fly is black or dark brown, slender, with a club shaped abdomen and hyaline wings. The third and fourth abdominal tergites are marked with a basal pair of pale yellowish spots. The length of the fly is about 10 millimeters.

Baccha lugens was quite rare in the region around Orlando during 1924. The larva is quite different from that of the above species, being smooth and much darker in color, tinged with purple when not feeding, with ir-

regular cream colored and pink areas. The puparium is quite distinctive in shape, the anterior portion greatly inflated, the posterior portion abruptly flattened and contracted. The color is pale, dull brown, with few markings. The adult fly resembles *Baccha clavata*, but the dorsum of the thorax is blackish bronze, the abdomen dull black with an apical violaceous portion. The wings are distinctly clouded with dark gray.

Baccha clavata is parasitized by *Pachyneuron siphonophorae* (Ashmead), a small hymenopteron at one time considered a primary parasite of the aphid *Siphonophora citrifolia*, described by Ashmead from material taken at Tildenville, Florida. A species of Pachyneuron has been repeatedly reared from *Toxoptera gramimum* and it is considered a secondary parasite, and there are several rearing records, some of which are given in U. S. D. A. Bulletin 110. In the case of *P. siphonophorae*, as many as eight individuals were bred from one puparium. Probably ten per cent of the puparia were parasitized at Orlando, Florida.

An undetermined hymenopterous parasite was reared from the puparia of *Baccha lugens*, a single parasite from a puparium.

AGROMYZIDAE. In his Orange Insects Hubbard described a fly, the larvae of which were often found preying on aphids on oranges. This species was called the Pruinose Aphis-fly by Hubbard, and no technical name was given it. Specimens sent to Dr. Williston at the time were unknown to him and were thought to be Anthomyids of an undetermined genus. The form found preying on the citrus aphid is *Leucopis americana* Malloch, an agromyzid fly belonging to the subfamily Ochthiphilinae. It is interesting to note that Malloch reared this species from larvae feeding on aphids on *Spiraea vanhouttei* at Urbana, Illinois June, 1917. The species was said by Malloch to be the commonest of the genus in Illinois. It has been referred to in literature as *nigricornis* Egger, a European species. Malloch described the species in Vol. XIII, article XIV, Bulletin of Division of Natural History Survey, Urbana, Illinois, pp. 354, 355, 1921, in a paper on the subfamily Ochthiphilinae. Malloch also described the puparium in this paper.

The egg of *Leucopis americana* is white, long oval, the surface marked with fine longitudinal lines. The larva is small (about 3 millimeters in length) and pale green in color, the dorsal surface of the body covered with minute projections or papillae. The posterior end of the larva is rounded and is furnished with two long spiracular appendages. The larval skin hardens to a brown puparium, the spiracular tubes being very prominent. The larva before pupating fastens itself to a leaf or twig by means of a black gum it secretes; it may be either on the stems (in case of

Spiraea) or on the leaves. The adult is a small, compact, gray pollinose fly, with yellow marked legs, the front tarsi largely black, and hyaline wings. The dorsum of the thorax usually has two brown stripes.

Distribution of Predators

Of the several natural enemies of *Aphis spiraecola* discussed above only two are commonly found in colonies on *Spiraea*, the native host plant, at Orlando, Florida; these two predators are *Scymnus cervicalis* and *Leucopis americana*. We can only guess at the reason for the absence of the other predators. Probably the main reasons are physical. The "flush" on orange rapidly curls when attacked by *Aphis spiraecola* and offers protection to both aphids and aphid enemies. The stems and leaves of *Spiraea* are comparatively small and do not allow much room for a large predator. Most of the aphids are clustered on the slender stems and as the leaves do not curl the predators are exposed to sun and weather and to any casual enemies.

President A. F. Burgess: Mr. Cole somewhat summarized his paper and I think as long as there is another paper relative to the Citrus Aphid we should hear that before we adjourn. At the close of this paper we will discuss the two together.

I will now call on Dr. Baker for his paper.

THE CITRUS APHID OUTLOOK

By A. C. Baker, *Washington, D. C.*

(Withdrawn for publication elsewhere)

President A. F. Burgess: We will now take up the discussion of the last two papers.

Mr. E. P. Felt: I would like to ask Dr. Baker if from his experience he doesn't feel that aphid outbreaks are to a large extent dependent upon favorable climatic conditions.

Mr. A. C. Baker: In reply to that question, I would say that is the case. There are, of course, two entirely different types. For instance, you get an outbreak of the citrus scale in warm or hot weather, and with insects of this nature you get just the reverse, but they are very responsive to changes of that kind.

The meeting adjourned at 12:30 p. m.

PYRALIS FARINALIS LINN. (LEPIDOPTERA)—AN ALFALFA HAY WORM IN KANSAS[1]

By NELLIE M. PAYNE

The true clover hay-worm, *Hypsopygia costalis* Fabr. is usually considered the chief if not the only larva infesting legume hays. However, near Manhattan, Kansas the larva of the meal snout-moth, *Pyralis farinalis* Linn. was by far the most important pest during the years 1917–1920. The true clover hay-worm was so infrequently found that it could be considered unimportant economically.

Pyralis farinalis Linn., is usually considered as a stored product or mill pest. However, C. V. Riley (1874) reports this species as associated with *Hypsopygia costalis* Fabr. in damaging clover hay. Chittenden (1896) states that *P. farinalis* Linn. may do similar injury to that of the true clover hay-worm.

The larva of *Pyralis farinalis* Linn. can be easily distinguished from others found under stacks. It is 12–15 mm. in length, of a smoky gray color, with the mid-dorsal blood vessel appearing as a distinct dark line. The head and pronotum are dark reddish brown. The meso- and metathorax are much wrinkled. The suranal plates are heavily chitinized. This larva has been repeatedly described in American literature on economic entomology. Among the important writers dealing with this insect are Harris (1841); Walsh (1868); Riley (1874); Chittenden (1894) and Dean (1913). The larva of *Setomorpha insectella* Fabr., were the most common in 1920–1921, near Manhattan, Kansas. They are much lighter in color than other larvae found under stacks. The prominent silk-glands showing through the integument distinguish *S. insectella* Fabr. larvae clearly from other larvae found in the stacks. The true clover hay-worm, *Hypsopygia costalis* Fabr., has a dark brown head and an almost black body. It ranges in length from 9–12 mm. A fourth Pyralid, as yet unidentified, is a sluggish yellow larva with a brownish red head. This species occurs very infrequently.

The pupae of *Pyralis farinalis* Linn. are 5–7 mm., in length and of a dark brown color when fully chitinized. They occur either free or in an irregular cocoon of webbing and excrement. The wings extend ventrally to the first segment of the abdomen, and are there fused to the body. The pupae of *Setomorpha insectella* Fabr., are enclosed in a firm, white, cylindrical cocoon. The wing cases extend ventrally to or beyond the

[1]Contribution No. 319 from Department of Entomology, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 115 of the Kansas Experiment Station.

tip of the abdomen and are free. The pupae of *H. costalis* Fabr. have been described as similar in appearance to *P. farinalis* Linn., but smaller and of a honey yellow color.

The adults of Pyralis differ decidedly from either *Hypsopygia costalis* Fabr. or *Setomorpha insectella* Fabr., which are the other common stack moths. The wings at rest form a triangle. Each vertex of the triangle thus formed is marked by a chocolate brown spot, bordered with a narrow white line. The ground color of the moth is light brown. The

Fig. 13.—Life cycle of *Pyralis farinalis* L., outer circle = two generations, inner circle = one generation.

true clover hay-worm has a ground color of brownish lilac and their fore wings bear a golden fringe and golden markings. The wings of *Setomorpha insectella* Fabr. assume a roof-like position when at rest. This moth is smaller than the others and of a mottled gray color.

Studies made by the writer both in the field and in the laboratory indicate that *Pyralis farinalis* Linn. may have either one or two generations a year. Some individuals have one generation and some two generations during the same year. Over-wintering always occurs in the larval stages. In the two-generation cycle there is a short summer generation and later one requiring a long period for hibernation and development. The summer larval period requires about 45–50 days. In the one-generation cycle the over-wintering larvae pupate in the late spring or early summer as do those destined to have two broods. Moths emerge and lay eggs which hatch in ten days to two weeks. The larvae from these eggs live over till the following spring. The time required for the various stages varies greatly. The pupal stage requires from five to thirty days with an average of fourteen to fifteen days. The adults live from two to eight days. The time relations of the two-and the one-generation cycles are shown in the accompanying chart in which the inner circle represents the one-generation, and the outer the two-generation cycle.

The type of injury to hay caused by *Pyralis farinalis* Linn. is quite characteristic. The extent of apparent infestation varies widely even in heavily infested stacks. Frequently there are pockets of wormy hay alternating with sound material. Stacks of baled hay and of loose hay are equally attacked. In some cases, bales of hay are securely webbed to planks beneath the stack. Damage may extend up as high as three feet from the base of the stack. The lower portion of this infested region is reduced to a mere mass of stems, excrement and webbing. Earth and sand are carried up high in the stacks, thus losses from wormy hay include not only hay consumed by the larvae but also hay made unfit for use through contamination with soil, excrement and webbing.

Near Manhattan, *Pyralis farinalis* Linn. has been greatly reduced in numbers by a small chalcid parasite of the genus Tetrasticus. In the summer of 1920 the parasitism ran as high as eighty per cent. The host larvae pupate but the moths fail to emerge. This parasite has been the chief factor in the replacement of *Pyralis farinalis* Linn. by *Setomorpha insectella* Fabr.

Summary

1. *Pyralis farinalis* Linn. usually a stored-products pest, was observed to be an important alfalfa-hay pest near Manhattan.

2. Both one-and two-generation cycles occur during the same year in hay.

3. Injury to hay consists in both hay consumed and in hay made unfit for use by webbing and excrement.

4. The chief natural control existing is a chalcid parasite.

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CONTROL OF APHIDS ON NURSERY STOCK

A. L. PIERSTORFF

ABSTRACT

Aphis pomi, *A. sorbi*, *Myzus cerasi* and *A. spiraecola* are successfully controlled by nicotine dust on a commercial scale. Cross transfers of *A. pomi* and *A. spiraecola* on apple and *Spiraea vanhouttei* are equally successful. Reaches the conclusion that *A. pomi* and *A. spiraecola* are same species.

The commercial control of aphids on nursery stock has been a perplexing problem to the nurseryman. Power machinery is highly developed for the use of the orchardist for fighting insect pests and plant diseases. However there is scarcely a power machine on the market that is practical for nursery work in controlling insects and diseases.

A practice that was generally followed a few years ago for combating aphids and is still largely used by many growers of nursery stock is "dipping" the plants. A solution of whale oil soap and water, one pound in 7 gallons, is placed in a large vessel and the tips of infested shoots bent over and submerged in the liquid. This is a laborious and expensive process and the results are not very encouraging.

During the seasons of 1923 and 1924 the writer was stationed in a field laboratory of N. Y. State College of Agriculture in Monroe County. The work was conducted in a large nursery where practically all varieties of deciduous fruit trees and hardy perennials are grown on an extensive scale. Splendid opportunity was afforded for the study of aphids infesting plants of this type.

During the season of 1923, severe infestations occurred on the one year old apple buds, apple seedlings and on the two years old *Spiraea vanhouttei*. The species present on the apple stock were *Aphis pomi*

and *Aphis sorbi*. A green aphis closely resembling *Aphis pomi* was seriously infesting *Spiraea vanhouttei*. The Spiraeas were given several applications of sulfur-nicotine dust but satisfactory control was not secured and considrable injury was done by the pest. Attempts to have the species on Spiraea definitely determined were unsuccessful.

At the close of the 1923 season it was planned to conduct experiments the coming season to throw some light on the identity of the species infesting Spiraea. It was believed by several workers to be identical with *Aphis pomi*.

On April 25, 1924, in Bul. 313, Dr. Edith M. Patch makes the following statement about the identity of *Aphis pomi* and *Aphis spiraecola* Patch: "My own present interpretation of the situation is that we are concerned with one very variable species." The name *Aphis spiraecola* was given by Miss Patch (Me. Bul. 233:270, 1914), for the species infesting Spiraea which had been recorded by Gillette as *Aphis spiraeela* Schouteden (Jour. Econ. Ent. 3: 404, 1910).

Caged Spiraea and apple plants were used in an effort to confirm the conclusions reached by Dr. Edith M. Patch (Me. Bul. 313, 1923). Two cages each containing four Spiraea plants and 2 cages each containing 4 apple seedlings were used. Insects were transferred from the field as follows: *Aphis pomi* collected from apple were transferred to one apple cage and one *Spiraea vanhouttei*. Green aphis collected from *Spiraea vanhouttei* were transferred to one apple cage and one *Spiraea vanhouttei*.

All colonies thrived and produced winged forms. This was repeated three times during the season. Microscopic mounts were made and identified as one species—*Aphis pomi*. These mounts were sent to Dr. Edith M. Patch for confirmation and pronounced correct.

It would appear then that the species causing such havoc on the Spiraea was *Aphis pomi*.

As *Spiraea vanhouttei* is grown on a large scale it became an important problem to locate the failure of controlling this pest by nicotine dust. It was subsequently discovered that the dust used had been on hand for some time, and although it was stored in air tight containers, it was evident that the percentage of available nicotine was small. It was also found that the combination of sulfur and nicotine would not make a dust that would satisfactorily release the nicotine.

A fresh supply of lime-nicotine, (2.7 per cent nicotine) was secured for the 1924 season. Two plots each 100 ft. long and 23 rows wide were selected in the block of Spiraea. Plot A was to be dusted and plot B

was to serve as a check. On July 2 plot A was dusted with 20 lbs. of 2.7 per cent lime-nicotine dust. At that time the first brood of descendants of the winged females was maturing on the Spiraea plants and practically all insects were to be found at the tips of the most vigorous shoots. A very light application with a hand blower gun killed practically all the insects. Plot B, and also the remainder of the block became severely infested and two weeks later, aphids were closely clustered on all parts of the plants. Five men were detailed from the nursery to dust the plants. Work was started on the afternoon of July 14th. There was little or no breeze. Each row was dusted once with hand machines, completing about one-third of the block that day. On the 15th a 20 mile breeze was blowing at right angles to the rows. It was found that if two adjacent rows were dusted that the next row on the leeward side would contain no live insects and about 50 per cent killing was obtained on the 7th row. The remainder of the block was dusted by treating two rows and omitting the third. Inspections, made that evening and the following days revealed practically complete control. Plot A which was dusted two weeks earlier was not treated again and remained free from aphids until about Sept. 15 when numerous colonies could be found throughout the block. No further treatments were necessary as the plants had made a good growth and would be dug before injury would be effected by the aphids.

Other nursery stock especially apple and sweet cherry became heavily infested with plant lice in 1924. It was necessary to treat several apple blocks two and three times in order to effectively control *Aphis pomi*. This was due to migration of the insects from old neglected sod orchards which abound in the vicinity. At each application equally good results were obtained and practically no live aphids could be found on the treated trees. When the first application was made about the middle of June, a fair per cent of the aphids present were *Aphis sorbi*. These colonies had curled the leaves severely and the writer was skeptical as to the success of killing the insects inside the curled leaves. Inspection made following the application showed this fear to be groundless.

All applications were made with hand blower guns which are perhaps the most effective machines available for the conditions encountered. Rarely is there a general infestation on all nursery trees and only those infested are treated thus effecting a large saving in materials and labor. On *Spiraea vanhouttei* where the infestation is general a power machine could be effectively used.

Myzus cerasi was abundant on one year old sweet cheerry stock but

one application of the nicotine dust proved effective even though the leaves were badly curled. Isolated colonies on sour cherry stock remained throughout the season.

The superintendent of the nurseries who has had wide experience in dipping infested plants, stated that the control of aphids by use of nicotine dust was the most economical and practical method that they had ever employed. At the present time many growers are discarding the whale oil soap solution and using nicotine dust or spray.

As a whole, the lime-nicotine dust mixture is by far the most satisfactory method of control for aphids in nursery stock.

ENTOMOLOGICAL DINNER[1]

As soon as the two hundred guests were seated, President Burgess introduced Dr. L. O. Howard as toastmaster. Doctor Howard announced that the Committee of Arrangements had fortunately been able to secure the return of certain famous old entomologists to this world for that night only. The oldtimers had been led to the effort by their intense interest in entomology, their curiosity as to modern times, and by the extraordinary opportunity of meeting so many entomologists at once. The remarks of the toastmaster and of each of the famous oldtimers are given below. The impersonations were admirable. Doctor Harris was impersonated by W. R. Walton, Professor Riley by Carl Heinrich, Doctor Fitch by E. R. Sasscer, Townend Glover by H. L. Sanford, Lord Walsingham by William Schaus, and Professor Westwood by W. B. Wood.

After these speeches, the toastmaster announced that the Committee of Arrangements had been able to materialize for the evening certain insects of the far future, intimating that the evolutionary tendency towards reduction in size had been reversed—the insects of the future would be very large. Then there entered the dining room five ladies made up to represent these future insects. Mrs. S. A. Rohwer represented the Japanese beetle, Mrs. J. A. Hyslop the gipsy moth, Mrs. T. E. Snyder a yellow-jacket, Miss Howard a blow-fly, Mrs. E. R. Sasscer *Desmocerus palliatus*.

During the dinner, the blow-fly was invited to "buzz," and Miss Howard read certain verses descriptive of supposed characteristics of certain well known entomologists present at the dinner.

TOASTMASTER: This is the year 1925, but for this night only there have returned to this world, urged partly by a feeling of curiosity, six ento-

[1]Held at Harvey's, Washington, D. C., January 2, 1925.

mologists of former days. Knowing of the presence in Washington of so many entomologists from all over the United States and that the present function would be on, they are here. It is one of the great pleasures and great honors of my life that I am permitted to introduce the present generation of entomologists to these men.

There is no entomologist of the last century who demands greater respect among the entomologists of today than Dr. Thaddeus William Harris. Professor Harris, allow me to present to you a crowd of your ardent admirers, men who have studied your immortal "Insects Injurious to Vegetation" and who have read everything about you that has been published since you left this world.

DOCTOR HARRIS: Young gentlemen and ladies, I have little to say to you except to express my gratification at the wonderful opportunity that has been given to me. The work which, in my feeble and solitary way I began, has grown beyond anything I could have imagined. In a sketch of my life and work by A. R. Grote he referred to an expression of mine, "There is another kind of moth found in Massachusetts." I beg to assure you that this was not a prophetic remark and that I had no reference whatever to the advent of the gipsy moth nor yet of the brown-tail moth—two insects which I understand have brought most unenviable notoriety to the State I love so well.

TOASTMASTER: A man who made a great mark in economic entomology and who for fourteen years was the chief of the federal organization was Prof. C. V. Riley. I hope he has been happier since 1894 than he was before that time. He certainly deserves it, from the good his admirable work has done. Professor Riley, let me introduce the entomologists of 1925.

PROFESSOR RILEY: Ladies and gentlemen, I anticipated all this. As I said in my . . . . Missouri Report, the work which I began will grow and the ideas which I am putting out in these reports and the facts which I have recorded will be of enormous value to the country. In a way, I may safely say that the credit for everything which has been done in scientific or applied entomology in the United States should be given to me.

TOASTMASTER: The earliest entomologist in the federal service was Townend Glover. He was, as you know, a most industrious and a very able man. He was not only an entomologist but a poet and had a sense of humor. He "kicked against the pricks" all his life. He was worried especially by chief clerks. But he left a reputation for honesty and

sincerity that makes us all think of him with admiration. Professor Glover, before you are the entomologists who have succeeded you.

PROFESSOR GLOVER: I am distressed to see that there are great collections of insects in several of the museums in this country. There should be no collections. All the insects should be illustrated. The illustrations will last; the Anthrenus will eat up the collections. The plates which I drew and etched during my life will be in existence when the national collection of insects has disappeared from the face of the earth. My advice to the younger generation is to turn you attention to the permanent things.

TOASTMASTER: There is not one of us who has not studied the writings of the fine old gentleman, Dr. Asa Fitch. He has always had our sincere admiration. We are grateful that entomology attracted him away from medicine. Doctor Fitch, let me present to you a group of your students and modern friends.

DOCTOR FITCH: I have many things to be grateful for. I am grateful that I was succeeded in my work by Doctor Lintner and later by Doctor Felt. I am glad that State politics have not prevented the prosecution of the work I began. I am grateful to be allowed to be here tonight. I am grateful for everything, except that one of my biographers told the story that at family prayer on one occasion I was in doubt whether to interrupt the prayer and catch a rare moth that had come into the room or to continue the devotional exercises. The story is perfectly true, but I had hoped that it would not be handed down to posterity.

TOASTMASTER: There was a famous Englishman, a man of great rank, a man famous in many ways, who nevertheless devoted great attention to that wonderful group of insects, the Microlepidoptera. Lord Walsignham, it has been a long time since I saw you, and a very much longer time since you visited the United States. Will you allow me to present to you more American entomologists than you ever thought would exist, and at the same time to thank you for your interest in American insects and in American entomologists and for your many kindnesses to us.

LORD WALSINGHAM: As I once told you, Doctor Howard, I had a great admiration for Riley and I approved very much of Busck's work. I have never forgotten my California experiences in the early eighties, and I sometimes tell anecdotes in the American dialect to my friends where I am living now (I won't say where), using as much of your charming American slang as I can remember. I see that old Durrant is still alive, and I sometimes peek through the door in the basement of the old British Museum to make sure that he is still caring for my collection.

It is a delight to see him hobnobbing with Walter Rothchild and the Abbé Joannis, and it is a joy to know that the provisions of my will are being faithfully followed out. I am sure that your National Museum will be all right so long as Schaus and Busck are there, but of course it will never equal the British Museum.

TOASTMASTER: Most of us have seen Professor Comstock's "Introduction to Entomology." All of us have seen an "Introduction to Entomology" published nearly a hundred years ago, and we turn to it even today. Dear old Professor Westwood, you never imagined the profit and pleasure that your work has given and will still give to generations of American entomologists, let me present to you some of your host of admirers.

PROFESSOR WESTWOOD: I was very fortunate, when I was alive, in having been an Englishman, for the English are great travelers and great collectors, and, without leaving England, I had the most extraordinary mass of material sent in. It is no wonder at all that I was able to do so much work. That my writings have been of help to you is a great satisfaction. I thank the toastmaster for the good things he has said about my work, but I confess that, as a rather shy Oxford man, I much prefer the English kind of toastmaster who simply introduces people without any comment whatever. Thank you.

Scientific Notes

Mirid Predaceous on European red mite.—On August the 19th the writer observed a Mirid nymph, *Hyaliodes vitripennis* Say, feeding upon a European red mite, *Paratetranychus pilosus* Can. and Panz. on apple foliage.

J. R. STEAR, *Assistant Entomologist,*
Penna. Bur. of Plant Industry, Harrisburg, Pa.

Coition of Melanoplus differentialis and Trimerotropis sp. In 1914, Somes made mention in his Acridiidae of Minnesota as having observed such diverse species as *Camnula pellucida* (male) and *Dissosteira carolina* (female), and also *Stenobothrus curtipennis* (male) and *Gomphocerus clepsydra* (female) in coitu. Up to this time, that is the only record of such an unusual phenomenon known to the writers. However, on October 1, the writers while making observations on grasshoppers near Akron, Washington County, Colorado, observed a pair of grasshoppers in coitu which were of different species. These were taken and determined as *Melanoplus differentialis* (male) and *Trimerotropis* sp. (female). (This species is not described in our collection, but belongs to the Cincta group.)

This is very interesting because two different sub-families as well as two different genera are represented in sexual union, an unusual phenomenon in insects. To the writers' minds this brings about the possibility of hybrids in insects which possibly

heretofore have been described as distinct species, as was proven by Palmer in her work with Coccinellidae.

By GEORGE S. LANGFORD and W. L. BURNETT, *co-authors*,
Colorado Agricultural College

Army Worm Egg Parasite. In the army worm outbreaks which have occurred in Illinois in the past, there has always been a very high percentage of parasitized larvae by the end of the outbreak, but it has also been possible to find some of the larvae unparasitized in the fields. While the per cent of unparasitized larva was low, the total number actually completing their development was usually large for any given brood. In 1919, studies of the eggs of the army worm showed the presence of a small chalcid parasite identified by J. C. Crawford, as *Telenomus* sp.[1]

During the army worm outbreak of the present season, a few additional studies of this parasite were carried on. It was found to be present in all fields where examinations were made, and in some cases the eggs were parasitized to the extent of from 40 to 60%. Apparently this insect is one of the chief, if not the chief, limiting factor in controlling outbreaks of the army worm.

W. P. FLINT

A New Formula for Making Lubricating Oil Emulsions. With the object of improving the stability and keeping qualities of lubricating oil emulsion, a series of experimental tests was made, based on the theory that an emulsion, made with an alcoholic soap, would reduce to a minimum the surface tension between the particles of oil, thus tending to hold the emulsion in its original form. In these tests, amyl alcohol or fusel-oil gave the most promising results when used in the following formula:

Potash fish-oil soap (about 65% water)	1 pound
Fusel-oil (amyl alcohol—technical)	4 ounces (liquid)
Lubricating oil (spec. gravity—.88 to .90)	1 gallon
Water	½ gallon

Directions: Into the proper amount of soap stir the fusel-oil very carefully, then add the lubricating oil slowly with vigorous stirring until the mixture has the appearance and consistency of an oily salve. Stir the water into this "salve," until a typical creamy emulsion is formed.

It is very important that the fusel-oil be well stirred into the soap. The ingredients cannot be added in another sequence with satisfactory results. Pumping is not necessary. The emulsion does not rot or ferment. Using the red engine oils in this formula, we have made excellent emulsions, which are in good condition eighteen months after being made. As with other emulsions, the stability of the emulsion is increased in direct proportion to the softness of the water, and *very hard* water may need to be softened before being used in this formula. The city water of New Orleans has always made a good emulsion of this kind. In dilute form it retains its stability when mixed with Bordeaux mixture and nicotine sulphate.

Satisfactory emulsions have been made by using potash fish-oil soap with all available grades of lubricating oil and also by substituting dissolved hard soap, such as soap flakes, for the potash fish-oil soap. The best results have been obtained when using red engine oils having a specific gravity of .88 to .90.

At present there is a limited amount of fusel-oil available, the supply being governed by the demand.

[1]Vol. IX, No. 3, p. 377, "Journal of Economic Entomology."

Based on the prices quoted at New Orleans for reasonably large quantities of potash fish-oil soap, red engine oil, and fusel-oil, the materials to make one gallon of this emulsion cost about 30 cents. No equipment for heating or pumping is necessary and the cost of the diluted emulsion containing two percent of oil, is approximately one cent a gallon.

Experiments in the control of the Camphor Scale, the Florida Red Scale, the Dictyospermum Scale, the Purple Scale, the Long Scale, and the Palm or Cocoanut Mealybug with cold-stirred emulsions of this kind have given very good results. Comparative tests of the effectiveness of lubricating oil emulsions made by this formula and by the standard, boiled-pumped formula show an advantage in favor of the modified formula in the majority of cases, indicating some insecticidal value of the fusel-oil.

No evidence of injury to plants other than is caused by similar emulsions made by other formulae, has been apparent.

The ease of preparation, the simplicity of necessary equipment, and the high insecticidal effectiveness of emulsions made by this formula make it of considerable value to nurserymen, florists, and gardeners when they have need for an easily prepared, effective contact insecticide.

W. D. WHITCOMB,
U. S. Bureau of Entomology

Preliminary Note on the Control of Grape Leaf Hopper with Calcium Cyanide Dust. During the season of 1924 experiments were conducted by the Pa. Bureau of Plant Industry at the Field Station, North East, Pa., to test the value of calcium cyanide dust as a control for the Grape Leaf Hopper in commercial vineyards. Both calcium cyanide "A" and "B" dusts were tested and the material was applied either with a hand or power duster. The "B" dust was applied at the rate of 40 lb. to the acre and the "A" dust at the rate of 25 lb. per acre. In the case of the "B" dust both sides of the row were dusted while with the "A" dust only the windward side received the dust. The dusting was done at the regularly recommended period for the application of the leaf hopper spray in Pennsylvania, i. e. when the majority of the first generation nymphs were in the fourth instar and before an appreciable number of second generation adults had appeared. At this time it was possible to observe the effect of the dust on both the adults and nymphs. The temperature when the dust was applied varied from 70 to 75 degrees F., and the relative humidity from 60 to 80 percent.

In addition to the customary counts of adults and nymphs before and after dusting, collections were made by placing canvas beneath dusted vines and observations were made for 30 minutes after dusting. An exceedingly high percentage of adults and nymphs were killed by both the "A" and "B" dusts. As already noted by Quayle (1924) in a previous number of this publication, very few of the fallen hoppers recover when the ground is covered with particles of calcium cyanide dust. In the case of the nymphs however it was observed that many do not fall from the foliage, as do the adults, but remain clinging to it even when dead.

J. R. EYER, *Entomologist,*
North East Lab., Pa. Dept. of Agriculture, North East, Pennsylvania

A Preliminary Report on How the Cotton Boll Weevil takes up Poison. For years we have known that Calcium Arsenate dust will control the boll weevil, while a liquid spray gives poor results. The weevil does its feeding on the square inside the shuck where no poison is present.

By observation one can see that, as the boll weevil crawls over any surface, its snout has a characteristic up and down motion somewhat similar to the bobbing of a chicken's head. This in itself would account for close contact between the mouth parts of the weevil and the surface over which it moves and provides an accidental and unavoidable means for the introduction of the poison into the weevil's stomach.

Experimental work along this line became possible when we found a cultural medium which efficiently substituted the normal food, cotton plants. The following sets of experiments were carried out: on numerous occasions during the past year: (*a*) Boll weevil with food but no "dust" (Check tests) (*b*) Boll weevil with snout dipped into "dust;" with food. (*c*) Boll weevil with snout dipped at 12 hour intervals, with food. (*d*) Boll weevil allowed to crawl through a fine line of "dust," thereby dipping its own snout; with food. (*e*) Boll weevil with poisoned food. (*f*) Boll weevil with "dust" but no food. (High mortality rate because the mandibles were used in efforts to escape from the petri dish.) (*g*) Boll weevil with various parts of the body dipped into "dust" so placed that it could not be knocked off to subsequently get to snout.

These experiments showed by mortality rate data that the weevil gets the poison on the snout tip accidentally and later, when chewing or moving its mandibles, introduces the poison into the gut.

The action of calcium arsenate dust during cage experiments, with the first day's mortality rate at about 50%, second day 80%, third day 95% to 100% can be explained by the fact that a boll weevil can be placed in a dish of "dust," removed after a while, and continue to live. This may be ascribed to the firmly locked mandibles which are opened only when the insect is feeding or boring; naturally, if the "dust" has been knocked off the snout tip before the mandibles are opened, there will be no poisoning.

Actual poisoning by feeding does occur in syrup mixtures. The accident element here is restricted to the boll weevil's approach to the mixture, which, in no case, has been made to attract the weevil. A significant fact is that a syrup-calcium-arsenate mixture sprayed onto cotton does not give practical poisoning results. This is due to the drying of the spray solution, forming a varnish-like film of poison which does not adhere to the snout of the boll weevil crawling over the poisoned area. With "dust" the poisoning is effective, as the "dust" particles are loosely attached to the surface and easily adhere to the dipping snout of the crawling weevil. Consequently we have a large per cent. mortality when "dust" is thoroughly scattered, while other poisons, such as syrup and spray mixtures are more or less unsatisfactory.

EDGAR F. GROSSMAN, *Assistant Entomologist,*
Georgia State Board of Entomology

Ibalia ensiger Norton on Monterey Cypress: The burning of Hearst Hall on the campus of the University of California in June 1922 caused the death of a number of trees, among them three Monterey Cypress. On November 25, 1922, I found eleven specimens of *Sirex behrensii* Cress. and two specimens of *Sirex areolatus* Cr. on the trunks of these trees. All but one were rigid in death with their ovipositors embedded

in the wood. One *Sirex areolatus* was moving slowly over the bark. No indication of larval work was found. Roaming over the tree trunks or with ovipositors inserted in them I found twenty-one females of the species *Ibalia ensiger*. The ease with which they removed their ovipositors when disturbed leads one to believe that they used the holes made by the Siricidae. Those of the Siricidae that failed to remove their ovipositors stood guard over their young, protecting them from the Ibalidae.

STANLEY E. FLANDERS

ANNUAL MEETING OF EXTENSION ENTOMOLOGISTS, 1924

The annual meeting of extension entomologists and entomologists interested in insect control methods was held at the Harrington Hotel, Washington, D. C., on the evening of January 1, 1925. The meeting was called to order by Chairman, H. E. Hodgkiss and was attended by 75 entomologists.

A paper dealing with "The Relation of Investigation and Extension Work in Entomology" was read by Dr. T. J. Headlee of New Jersey. Mr. A. B. Graham, of the Office of Extension, U. S. Department of Agriculture, addressed the meeting on the subject, "How the Extension Entomologist can be of most value to his State." The above subjects were followed by a short discussion by Prof. George A. Dean who emphasized the close relation and interdependence of extension and research and the aid to the college and research work which can be given by the present extension system.

Short talks were made by members present on topics connected with state extension programs. T. H. Parks of Ohio spoke on the organization and following of a state extension program. C. R. Crosby described the method in use in operating a spray service for orchardists in western New York. E. G. Kelly reported on the results of a correspondence course in entomology offered to teachers of agricultural schools in Kansas. W. P. Flint read a paper on the use of motion pictures in extension work. J. A. Hyslop of Washington, D. C., discussed the subject of a possible field for a publication on entomology extension. J. J. Davis told briefly of plans under way in Indiana for promoting boys and girls insect collection contests.

A resolution was adopted extending to the American Association of Economic Entomologists a vote of thanks for its courtesy in allowing this group a time and place of meeting during its annual meeting. Officers elected for the coming year were: Chairman, W. P. Flint, Secretary, Otis Wade.

The next meeting will be held at Kansas City, Missouri, during the annual meeting of the American Association of Economic Entomologists.

T. H. PARKS,
Secretary

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1925

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $2.50 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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The entomologists' dinner was a most enjoyable affair and the Washington entomologists are to be congratulated most highly upon the unique program. It was a triumph in materialization which would occasion apologies from no medium. The wand of science was waved, as it were, and a group of early leaders appeared and favored their numerous followers with wise counsel. Another wave of the magic staff and insects of the future drifted in on gentle air-currents, losing nothing of interest to either our predecessors, on earth for only a brief visit, or those still earnestly engaged in upholding the present high standards of lofty concentration upon things scientific, because the preincarnation of certain hexapoda was enhanced by a very attractive comeliness. It is feared that this last aroused a certain jealousy among the few ancients permitted to appear in our midst for so short a time. It is understood that one of the present day leaders silently vowed to retain headquarters in Washington for a little longer. Even entomologists are human at times.

The Washington meeting with its large attendance and congested program aroused considerable interest as to the best methods of handling the program in the future. The attendance and character of the annual meetings vary so much from year to year, that arrangements at one meeting may not be admissable or necessary at another. It is evident, that something must be done in the near future to relieve the congestion. There has been objection in the past to more than one entomological meeting at the same hour. Symposia are advocated and are undoubtedly of great value. The limited time now available eliminates much discussion. There is even difference of opinion as to how much discussion is

advisable. All are probably agreed that the program of the last meeting was handled in the best possible manner under the conditions obtaining. It has certainly been the policy of the officers to carry out the wishes of the Association as far as they could be ascertained. There are four possible methods of meeting the situation: 1. More time, say another day, could be given to the sessions. This would probably involve the meeting of one or more sections at the time the Entomological Society of America is holding its sessions. 2. The meeting of two or more sections or special groups of the economic entomologists at the same time. 3. The presenting of some papers as abstracts, possibly distributing copies just before the paper is called, and using most of the time in discussion that has been saved by not reading the paper. By mutual consent among the authors of a group of papers this could be tried in a limited way at the next meeting. 4. The program could be limited to papers of general interest and those of restricted application read by title and if considered worthy published as part of the proceedings. This last might not appeal to the Secretary or to a special committee. There are objections to all of the above methods. The problem is to find the solution which will serve best the interests of all entomologists. There are doubtless many who desire to attend every entomological session held at the annual meeting, and also hear portions of the program of other biological societies. It just can't be done under present conditions. We can only weigh the probabilities, make a choice and accept the inevitable limitations with the best possible grace.

Religious differences have always been marked by bitterness and in the early days dissenters were easily silenced by beheading, a beautiful custom which seems to have fallen in the discard in late years. The professional beheading of Dr. Henry Fox, till recently an instructor in Zoology in Mercer University, Macon, Georgia, simply because certain personal beliefs did not agree fully with the opinions of a board of trustees, brings this question of tolerance to the fore once more. There was no dissatisfaction with the service rendered. It was simply fear of Scriptural unsoundness or something of that nature. There is no question as to the right of a governing board to pass upon the qualifications of its servants. It is a little unusual to suddenly decide after a period of very satisfactory service, that conditions have become dangerous. This remarkable situation has developed in a denominational institution in relation to one of its own members in unquestioned good standing in the church. It is legitimate to ask if this action correctly reflects the attitude of the Baptist church in the south and throughout the country?

It has generally been held that educational institutions stood for a fearless presentation and investigation of truth. Some apparently are more concerned in the propagation of certain opinions. The church for centuries has made great efforts in a battle against facts. Its representatives denied that the earth was round, that the earth revolved around the sun, that the blood circulated, etc. Present day representatives in some quarters are attempting to insist that their interpretation is the only correct one. There is no real conflict between religion and science. The churchman and the scientist are both keenly interested in learning the truth, or at least that should be their attitude. The church needs the support of the scientists and they in turn would benefit immensely by intimate contact with a church taking a fearless stand in relation to the great truths or natural laws dominating the universe. No man can gainsay truth. Shall it be said in the future that larger branches of the present day church have been struggling as of old against the inevitable? Mercer University has honored Dr. Fox by dismissing him. Evidently it has no use for an earnest student of the Scriptures who dares to hold opinions. The world needs such men, not for the purpose of propagating strife but as leaders in the development of a christian citizenship worthy of our great nation.

Review

Anatomy and Physiology of the Honeybee by R. E. SNODGRASS, pp. i–xvi, 1-327, 108 figures, First edition, McGraw-Hill Book Company, New York, 1925.

In 1910 the author published as Technical Bulletin 18 of the Federal Bureau of Entomology an extensive bulletin on the anatomy of the honeybee. The edition was soon exhausted and for several years there has been a demand for his work which could not be filled. Now in enlarged and much improved form and contents this work appears as a book. The title of the book gives its contents so that every worker in this field will know exactly what to expect in it and no detailed account of the contents is required by way of review. The inclusion of physiology is an important addition. The ability of the author as an artist is so well known to all entomologists and his standing as an insect morphologist is so recognized as to ensure that in this book we find a sound account of the subjects covered. Few writers on scientific subjects today have as good a command of English as the author, and this book is written in a style to warrant the descriptive word charming, if one dares apply this word to a scientific book. In this book too the honeybee is a living animal, not a corpse. While many workers have written on the anatomy of the honeybee, and the anatomy of no insect has been so much discussed or so grossly misrepresented, this work is beyond question the best in its field and will long so remain. E. F. PHILLIPS

Current Notes

Mr. W. P. Hayes, Assistant Professor of Entomology at the Kansas College, has resigned.

Mr. W. L. Strong has been appointed Assistant Entomologist of the Virginia Truck Station, effective July 1.

According to *Science*, Dr. O. F. Hedenburg gave a lecture on Insecticides and Fungicides on October 6, in the course at Mellon Institute, Pittsburgh, Pa.

Mr. O. J. Harvey of the Florence, S. C., laboratory of the Bureau of Entomology, has resigned to accept a permanent position outside of the Federal service.

Mr. S. F. Potts, formerly connected with Columbus station of the Bureau of Entomology, is now taking postgraduate work at the Ohio State University, where he has a fellowship.

Mr. Geo. G. Ainslie, in charge of the Knoxville, Tenn., laboratory of the Bureau of Entomology was in Cincinnati November 11, to confer with W. H. Larrimer concerning the Hessian fly investigations.

Mr. N. J. Atkinson, who resigned his position at Saskatoon, Sask., in August, owing to ill-health, has recently sailed for England where he expects to remain for several months.

Mr. Enos B. Engle, for 23 years in charge of nursery inspection in Pennsylvania, and for 35 years Secretary of the Pennsylvania Horticultural Society, died December 9, aged 83 years.

Dr. W. R. Thompson, Bureau of Entomology, in charge of the European corn borer parasite laboratory at Hyères, France, recently made a trip to England in the interest of his biological investigations.

Mr. C. H. Popenoe, Associate Entomologist, Bureau of Entomology, is taking graduate work at the University of Maryland, College Park, Md., specializing in organic and physical chemistry with particular reference to their application to insecticides.

Mr. Geo. H. Bradley of the Mound, La., station of the Bureau of Entomology, is taking graduate work at Cornell University. Mr. H. E. Wallace of the same station is studying at the University of Minnesota.

Mr. Norman Allen, Junior Entomologist, connected with the Baton Rouge, La., laboratory of the Bureau of Entomology, and working under the direction of C. E. Smith, has registered for graduate work at the University of Louisiana.

Prof. Geo. A. Dean of the Bureau of Entomology visited the Carlisle, Pa., laboratory, November 22 to 24 to confer with Messrs. Myers, Hill, and Smith, who are engaged in the Hessian fly parasite investigations.

News has been received of the marriage of Miss Margaret Fagan, formerly of the Division of Insects, U. S. National Museum, and Mr. J. J. DeGryse, who is connected with the Entomological Branch, Canadian Department of Agriculture, Ottawa.

Dr. L. O. Howard gave the annual public address before the Entomological Society of America at the Cosmos Club, Washington, D. C., on the evening of December 31. His subject was: "The Needs of the World as to Entomology."

Mr. C. M. Packard, in charge of the Sacramento, Calif., laboratory of the Bureau of Entomology has been granted permission by the Secretary to do graduate work in Entomology at the University of California for the University year 1924–25.

Mr. Harlan N. Worthley, Assistant Research Professor in Entomology at the Massachusetts Agricultural College, has resigned, effective March 1st and has accepted the position of Assistant Professor of Extension Entomology at the Pennsylvania State College.

Mr. George M. List, Chief Deputy to the State Entomologist of Colorado, and Assistant Professor of Entomology and Zoology in the College has been granted a year's leave of absence to take up graduate work at the Iowa College.

Mr. D. J. Caffrey, in charge of the European corn borer laboratory at Arlington, Mass., was at Guelph, Ontario, November 27 and 28, to attend the meetings of the Ontario Entomological Society and conferences of the European corn borer workers.

At the Union Agricultural Meetings, Worcester, Mass., January 7–8, Mr. L. H. Worthley addressed the Mass. Vegetable Growers Association and Dr. W. E. Britton addressed the Mass. Fruit Growers Association. Messrs. Q. S. Lowry, Boston, and C. W. Lewis, Arlington, were also present.

In the Nicola Valley, B. C., Mr. E. R. Buckell is organizing several meetings to be held during the coming winter to arrange for the equipping of bait mixing stations and the hauling of bait supplies for the spring (1925) grasshopper campaign.

A conference of State officials, nurserymen and others interested, particularly with a view to safeguarding the movement of nursery stock out of the area infested by the Japanese beetle, was held at the U. S. Department of Agriculture, December 30, 1924.

Dr. H. E. Ewing spent a week recently at the Museum of Comparative Zoology at Cambridge, working with Nathan Banks on types of mites. On his way back to Washington, he made a visit to the American Museum of Natural History.

Mr. I. L. Ressler, formerly instructor in Zoology at Iowa Agricultural College, has resigned to accept a position as mid-western entomologist for the American Cyanamid Company and since January 1, 1925, has been at Kansas City, Mo., which will be his headquarters.

According to *Science*, Professor C. F. Curtis Riley, who has been connected with the department of Zoology at the University of Manitoba, and who was formerly at Syracuse University, Syracuse, N. Y., has been elected a fellow of the Entomological Society of London.

The gipsy moth scouting in Quebec terminated on December 13. In all of this work, approximately 2,300 miles of highway and 235 miles of railroad were examined. Over 2,000 new egg-masses were creosoted at the infestation at Lacolle, St. Johns County.

Mr. C. F. W. Muesebeck, of the Gipsy Moth Laboratory, Melrose Highlands, Mass., spent about three weeks during October in the Division of Insects, U. S. National Museum, studying the collection of Braconinae with a view to the publication of a revision of this group.

Mr. L. H. Worthley, in charge of the European corn borer control work of the Bureau of Entomology, was in Ohio, Michigan and New York from November 17 to 22, for the purpose of conferring with State officials and planning the work for next year.

According to *Science*, Dr. Filippo Silvestri, of the Agricultural School at Portici, Italy, has been appointed entomological explorer for the California Agricultural Station, with headquarters in Hongkong, China, in connection with a search for beneficial insects to strengthen the biological control of injurious insects in California.

According to *Science*, the following appointments have been made by the Tropical Plant Research Foundation, with headquarters at Washington, D. C.; Entomologist, Professor D. L. VanDine, formerly extension entomologist, Pennsylvania State College; Assistant Entomologist, Mr. C. F. Stahl, formerly assistant entomologist, Bureau of Entomology, U. S. Department of Agriculture.

Dr. J. F. Illingworth, stationed in China on the investigation of parasites for the green Japanese beetle for the U. S. Department of Agriculture, resigned at the end of the active season (Oct. 24), and returned to his home in Honolulu. His permanent address is care of the Bishop Museum, where he is giving attention to the distribution of insects of the Pacific region.

Mr. F. Anderson, Director of the West Indian Sugar Factory, St. Croix, Virgin Islands, recently donated to the U. S. National Museum a collection of St. Croix and other insects, mainly Coleoptera. The collection includes about 2,000 specimens, which have been accessioned and distributed to the various specialists.

Dr. J. D. Tothill, in charge of Forest Insect Investigations in the Maritime Provinces, Canadian Department of Agriculture, was granted a two years leave of absence from November 1, and sailed on that date for England. Later he will return and proceed to Suva, Fiji Islands, to investigate insect problems affecting the copra industry.

Mr. H. G. Crawford was absent from Ottawa in Western Ontario during the greater part of October, November and early December. The first part of the European Corn Borer Campaign has been completed, 40 meetings having been held in Essex and Kent counties, of which 25 were addressed by Mr. Crawford. The meetings were well attended.

Mr. K. M. King reports that the stomach contents of a sparrow hawk examined by the Department of Zoology at Saskatchewan University, contained the remains of some 30 or 40 grasshoppers, 4 large dragon-flies, a sphingid larva and 1 long-horned grasshopper. The usual food of this species is said to be small birds and mammals.

In the Entomological Branch, Canadian Department of Agriculture, several Junior Entomologists have completed their seasonal appointments and returned to their studies, as follows: R. D. Bird, Manitoba University; R. M. White, MacDonald College; H. E. Gray, Montana State College; L. H. G. Clark, University of Saskatchewan; Insect pest investigators and laboratory helpers as follows: T. H. Owens, A. K. Graham, Geo. Hammond, T. Armstrong.

Mr. K. W. Babcock, Bureau of Entomology, who has been making ecological studies of the European corn borer in Hungary and Italy during the past season, is now at the European corn borer parasite laboratory at Hyères, Var, France. He will remain there during the winter, and will resume his ecological studies in Hungary and southern Russia next spring.

Mr. H. L. Viereck was away from Ottawa for a period of two weeks in November visiting Quebec, P. Q., where, thanks to the courtesy of Canon V. A. Huard, he was able to work over the historic Provancher collection. It will now be possible to

harmonize the determinations of the Hymenoptera in the National Collection at Ottawa with Provancher's work.

Mr. C. N. Ainslie, Entomologist in charge of the Sioux City, Iowa, laboratory, of the Bureau of Entomology, returned October 21 from a trip to northeastern Montana, where, in company with Dr. J. R. Parker of the Montana Experiment Station, he made a survey of the new infestation of the Hessian fly. He reports a serious infestation of the fly in northeastern Montana and northwestern North Dakota.

Mr. Arthur Gibson, Dominion Entomologist, delivered a brief radio address from the Canadian National Broadcasting Station, Ottawa, on the evening of December 10. The title of his talk was "The Fight Against the Insects." Mr. Gibson was recently honored by being elected a Corresponding Member of the American Entomological Society, the oldest entomological society in America, established in 1859 as the Entomological Society of Philadelphia.

Mr. J. C. Bridwell, who has continued his interest in work on bruchids, has resigned his position at Columbia University and has become manager of the Bombay Office of the United States and India Corporation, 17 Battery Place, New York City. Mr. Bridwell's present address is "Care of National Bank of India, Ltd., Bombay, India." Mr. Bridwell in interested in the importation into this country of dried food products.

The Second Annual Conference of Indiana Entomologists met at Purdue University, Lafayette, Indiana, December 4, 1924. Those in attendance included E. B. Williamson, Bluffton; Brandt Steele, Indianapolis; A. C. Kinsey and Ralph Voris, Indiana University; B. A. Porter, Vincennes; W. H. Larrimer, H. R. Painter, and W. B. Noble of the U. S. Entomological Laboratory, Lafayette; and C. R. Cleveland, W. A. Price, J. Troop, C. Carr, B. E. Montgomery, R. Montgomery, and J. J. Davis, of Purdue University. J. S. Hine of Ohio State University was a visitor.

Mr. G. F. Moznette has been authorized by the Federal Horticultural Board to proceed to Brazil, Argentina, Chili and Peru to make a fruit fly survey of the fruits and fruit cultures of those countries. He expects to be away from his headquarters at Miami, Florida, for about four months. This investigational work is to be carried on in order that definite information may be available in regard to the danger and possibility of introducing fruit flies with importations of fruits.

Officers of the Entomological Society of America for the coming year were elected at the Washington meeting as follows: President, Geo. A. Dean; First Vice-President, Lawson Caesar; Second Vice-President, Paul S. Welch; Secretary-Treasurer, C. L. Metcalf; Members of Executive Committee, E. P. Felt, G. W. Herrick, E. C. Van Dyke, J. A. G. Rehn, F. E. Lutz, Edith M. Patch; Councillors to the American Association for the Advancement of Science, W. A. Riley, W. E. Britton.

In October two colonies of *Schedius kuvanae* How. were sent to Madrid, Spain, and one colony to Rabat, Morocco by the Bureau of Entomology. At each of these places there is a heavy gipsy moth infestation. This egg parasite, which was introduced into New England from Japan, is now well established in the southern part of the area of New England infested by the gipsy moth. *Schedius* has several generations each year, and if it is established in Spain and Morocco it should become for those countries a valuable parasite of the gipsy moth egg.

The last of June puparia of *Compsilura concinnata* Meig. were sent to California in an attempt to establish this parasite in that State. *C. concinnata* is one of the tach-

inids introduced from Europe as a parasite of the larvae of the gipsy and brown-tail moths. This species is not only well established in the gipsy moth area but has been recovered from native insects about 100 miles west of the gipsy moth quarantine line. *Compsilura* has a large number of native insect hosts and it is hoped that the species will become established in California.

Messrs. M. B. Dunn and E. B. Watson returned to Ottawa on December 10 from Thor Lake, Sudbury district, Ont., where they have been surveying a recently discovered spruce budworm infestation. A severe outbreak of this insect is in progress in the country drained by the Wanapitei and Sturgeon Rivers. The cruising carried out indicates that the outbreak is very extensive and it has evidently been in the district for two years, the numerous egg-masses present presaging a heavy attack next June. Sample plots have been established in various types of forest and further work is planned for 1925.

On September 15, 1924, Dr. J. H. Grisdale, Deputy Minister of Agriculture, accompanied by Messrs. L. S. McLaine and W. N. Keenan visited the scene of the gipsy moth outbreak at Lacolle, Que. On October 1, a conference was held at Champlain, N. Y., to discuss the general situation. Among those present were Mr. A. F. Burgess, Mr. S. S. Crossman, Mr. Harry Blaisdell of the U. S. Bureau of Entomology, Mr. H. L. McIntyre and Dr. E. P. Felt of New York State, Mr. V. Baillarge of the Quebec Department of Lands and Forests, and Messrs. J. M. Swaine, L. S. McLaine and S. H. Short, of the Entomological Branch.

According to *Science*, Edwin H. Bryan, entomologist on the staff of Bernice P. Bishop Museum, has returned to Honolulu after a cruise of nine months on board the schooner France of the Whitney South Seas Expedition. February and March were spent at Nassau, Puka Puka, the Phoenix Islands and Fakaofo; April and May in Samoa; and the time from June to November was given to a study of the Fiki Archipelago, particularly of the little known islands lying between Viti, Levu and Tonga. The collections made by Mr. Bryan are chiefly insects, land shells and plants; his notes include also ethnological and geological material.

As a result of the spread of the European apple sucker in Nova Scotia, and its discovery in Westmoreland and Albert counties, New Brunswick, in 1924, necessitating a revision of the quarantine regulation, public hearings were arranged by the Destructive Insect and Pest Act Advisory Board, and held at Moncton on December 2d, and at Kentville on December 3d. Mr. Arthur Gibson, the Chairman of the Board, and Mr. McLaine as Secretary, attended the meetings. The advisability of including the whole province of Nova Scotia in the quarantined area as well as the two counties in New Brunswick was discussed and the matter will be definitely decided upon at an early meeting of the Board.

Dr. J. M. Swaine was absent from Ottawa during the first two weeks of November visiting Washington, D. C., where arrangements were made for the shipment of part of the Washington collection of Ipidae to Ottawa for study; and in company with Dr. F. C. Craighead, went to Tallulah, La., where a complete demonstration of the value of dusting planes in control work over forest lands was given. It was found that the insecticide dust thus applied penetrated through the densest foliage and should prove a very satisfactory method of controlling defoliating forest insects on small areas of timber. When certain problems connected with the expense and safety of operation are solved this method may come to be of great value in general forest control work.

In a large shipment of insects recently received at the U. S. National Museum from Rev. D. C. Graham, collected in the mountainous western portion of the Province of Szechwan, China, were included several boxes of Diptera, comprising the finest lot of Oriental insects of this group ever received at the Museum. Previous shipments from Mr. Graham were invariably more or less damaged by mold while in transit across the lower and more humid portion of China. The present lot, however, came through in perfect condition, apparently because of the fact, noted in the collector's diary, that he thoroughly dried his insect collection in the oven of an American stove. Some of these flies are easily recognized as belonging to European species; others occur in the East Indies and in the direction of Australia, while some very striking forms have been hitherto entirely unknown.

Messrs. L. H. Worthley, E. G. Brewer, and Professor George A. Dean spent several days in the early part of October inspecting the European corn borer infestations in Ohio, Michigan and Ontario. During the two days inspection trip in Ontario they were accompanied by Arthur Gibson, H. G. Crawford, L. S. McLaine, and Prof. Lawson Caesar. An important corn borer conference was held at London, Ontario, October 10. In addition to the entomologists, the conference was attended by the Dominion Minister of Agriculture, the Ontario Commissioner of Agriculture and the Agricultural Agents of Ontario. In many parts of Kent and Essex Counties, Ontario, where corn is the principal crop, the corn borer has increased from less than one per cent stalk infestation of last year approximately to 85 per cent stalk infestation this year, and from no commercial damage of a year ago to as high as 25 per cent. commercial injury in some fields of dent corn. The spread of the infestation in Michigan has increased fully 300 per cent. In addition to an increase of 150 per cent in the spread of the infestation in Ohio, there also has been a marked increase in intensity of the infestation. The spread of the infestation in Pennsylvania has also increased about 150 per cent. Messrs. Worthley, Dean and Brewer also attended a corn borer conference held at Columbus, Ohio, October 11.

The annual meeting of the Northwest International Committee on Farm Pests was held at Bozeman on August 27–28, 1924. The meeting was held in Lewis Hall, the splendid new biology building at Montana State College. Most of the delegates arrived the evening before and a picnic supper eaten on the college campus served as a get-together meeting. Two days were spent in discussing the more important cereal and forage insect problems of the northwest. The principal insects discussed were cutworms, grasshoppers, the wheat stem sawfly and the Hessian fly. It was the consensus of opinion that the first three insects were on the decline but that the Hessian fly was extending its range and causing an increasing amount of damage in the northwest. The programs for the most part consisted of informal round table discussions concerning the control and investigation of pests which were of vital interest to the northwest and it was the opinion of all present that much was gained by such an exchange of ideas. It was voted to hold the 1925 meeting at St. Paul during the latter part of August. Mr. Norman Criddle was continued as President and Prof. A. G. Ruggles was elected Secretary. Following the meeting a three-day collecting trip was spent in Yellowstone Park. Those present at the meetings were: Norman Criddle, Treesbank, Manitoba; K. M. King, Saskatoon, Sask.; A. V. Mitchener, Winnipeg, Man.; H. L. Seamans, Lethbridge, Alberta; George A. Dean, Washington, D. C.; A. G. Ruggles, St. Paul, Minn.: Stewart Lockwood, E. J. Udine,

and Robert Shotwell, Billings, Mont.; W. C. Cook, J. R. Parker, Frank Cowan, Mauro Rodriquez and Walter Stanley of Bozeman, Mont.

Notes on Medical Entomology

A consignment of Brazilian mosquitoes collected by Dr. J. Bequaert, of the Harvard Medical School, was recently received by Dr. Dyar and Mr. Shannon, of the U. S. National Museum. It included a number of species new to the National Collection, including four new to science, one of them being a species of *Anopheles*.

Professor Brumpt, of the Medical School in Paris, has been spending some days in Washington, and while there called upon several specialists in the Division of Insects, U. S. National Museum. He was especially interested in examining specimens of the hemipterous genus *Triatoma* from South America, since some members of this group are concerned in the spreading of chagas fever.

Mr. W. E. Dove, Bureau of Entomology, who has been collaborating with Dr. J. L. Kirby-Smith of Jacksonville, Fla., in an investigation of the causative agent of a creeping eruption on the skin of human beings, is now in Washington and is collaborating with Dr. G. F. White in a study of microscopic material. It is strongly suspected that the causative agent is a mite.

The American Society of Parasitologists was organized on December 30, 1924, at the Central High School, Washington, D. C. A tentative constitution and by-laws were adopted and the following officers and councillors elected: President, H. B. Ward; Vice-President, S. T. Darling; Secretary and Treasurer, W. W. Cort; Members of the Council; F. C. Bishopp, C. A. Kofoid, W. A. Riley, E. E. Tyzzer, R. W. Hegner, B. H. Ransom, P. S. Bartsch, C. W. Stiles. A motion was passed that the society apply for affiliation with the American Association for the Advancement of Science.

Notes on Apiculture

Among recent books is Dengg's "Praktische Königinzucht auf natürlicher Grundlage."

The Iowa Beekeepers' Association announced its annual meeting to be held at Des Moines, December 17 and 18.

In France there was recently discovered a worker-bee in Oligocene deposits. The specimen was well-enough preserved for identification purposes.

The Michigan Agricultural College will give a two weeks short course for beekeepers, February 9–25, assisted by leading authorities from other states.

Two new bee-journals have appeared, one from Scotland entitled "The Scottish Beekeeper," and the other from Argentina entitled "La Revista de la Apicultura."

Doctor von Buttel-Reepen, the well-known European writer on bees, has become Director of the National Museum of Natural History in Oldenburg, Germany.

The Worcester County, Mass., Beekeepers' Association held its winter meeting in the Armory at Worcester, January 6, in connection with the Union Agricultural meetings.

The examination recently announced by the United States Civil Service Commission to fill the position of assistant physiologist in bees for the Bureau of Entomology was closed on December 3.

Mr. C. Vaillancourt in charge of beekeeping work for the Province of Quebec and Editor of *L'Abeille*, has inaugurated a circulating apicultural library for the benefit of beekeepers in the Province.

The winter meeting of the Indiana State Beekeepers' Association was scheduled to be held at the Statehouse, Indianapolis, December 18 and 19, with several speakers of nation-wide reputation on the program.

Dr. E. F. Phillips gave a radio talk from Station WGY, Schenectady, N. Y., November 10, on "How Honey Bees Help Agriculture," and from Radio Station WGR, Buffalo, N. Y., on the evening of February 4.

During the past year Professor Park of the Department of Entomology at the University of Illinois, and in charge of the beekeeping courses there, received his Doctor's degree from the University of Iowa.

The 45th annual meeting of the Ontario Beekeeper's Association was scheduled to be held at the Prince George Hotel, Toronto, December 2–4. J. E. Crane and Allen Latham were listed as speakers from the states.

Recent visitors at the Bee Culture Laboratory included on January 5, Mr. Clay Lyle, representing the apiary inspection service of the State Plant Board of Mississippi, and on January 7, Mr. C. R. Cutright of the Ohio Experiment Station at Wooster.

A short course in beekeeping was held at the Ontario Agricultural College from January 12–24, under the direction of Prof. F. Eric Millen. Dr. E. F. Phillips of Cornell University assisted during the first week and Mr. C. B. Gooderham, Dominion Apiarist during the second week.

Luxemburg intends to quarantine for fourteen days all bees coming in from the outside to guard against foul brood. In 1923, Brazil followed the example of the United States in restricting the unlimited importation of bees because of danger of importing the mite, *Acarapis woodi*.

On December 30 at the instance of Dr. S. B. Fracker, representing the American Honey Producers' League, a conference was held at the Bee Culture Laboratory to consider the desirability and feasibility of a Federal Law in a national attempt to eradicate American foul brood as advocated by the League.

Following the short course at Ithaca, Messrs. C. P. Dadant and Jas. I. Hambleton attended series of special meetings for New York beekeepers held at the following cities: Albany, February 2; Syracuse, February 3, and Buffalo, February 4. Mr. R. B. Willson attended the first two meetings and Dr. F. F. Phillips the last.

The meeting of the Apicultural Section of the American Association of Economic Entomologists was exceedingly well attended. In fact, a larger meeting place would have been desirable. A resolution was unanimously adopted by the Apicultural Section commending Doctor Phillips for his services to American apiculture while connected with the Bureau of Entomology.

The Austrian beekeeping journals express much opposition to the ban on importing bees established by Germany to keep out the Isle of Wight disease. The interest dis-

played by Austria in this connection is quite apparent in view of the fact that 40 per cent of the colonies exported from Carnolia used to be consigned to Germany.

The *North Carolina Beekeeper* for 1924 has recently appeared and its editor, Mr. J. E. Eckert, deserves high commendation for its general appearance and make-up. This is the annual report of the North Carolina Beekeepers' Association. The 1923 report of the State Apiarist of Iowa, which appeared recently, is also worthy of mention as including several articles of note from prominent apicultural workers.

Europeans have taken to the use of the radio in bringing lectures to beekeepers. This should prove a big aid to the volunteer Wanderlehrer who, instead of spending many nights in addressing little assemblages here and there, can now speak to hundreds in widely separated communities on the same night. Switzerland appears to have been one of the first in Europe to have broadcast talks for beekeepers.

The Cornell Apis Club has been organized for the coming year. Mr. R. L. Parker of the Iowa Agricultural Experiment Station now on leave of absence for graduate study, is Chairman. A series of talks by various members of the club has been arranged for the first half of the year, on the life and work of the following prominent apiculturists: Francois Huber, L. L. Langstroth, Moses Quimby, Charles Dadant, Dr. C. C. Miller, A. I. Root and Isaac Hopkins.

Mr. R. L. Parker, Assistant Chief of Apiculture, Iowa Agricultural Experiment Station, Ames, Iowa, has been granted a nine months leave of absence in order to accept the Schuyler Fellowship in Animal Biology at Cornell University for the year 1924–25. He is taking graduate work there in the Department of Entomology (Apiculture) with Dr. E. F. Phillips, formerly of the Beekeeping Laboratory, Bureau of Entomology, Department of Agriculture at Washington, D. C.

Much interest is manifested in certain foreign countries in queen-breeding. Thus in Australia and New Zealand there have been certain state competitions with prizes awarded to owners of queens whose progeny possessed certain desirable qualities. In Germany at the present time the cry of queen-breeders seems to be to disregard color in breeding, and breed for certain qualities suited to each locality. The Swiss, on the other hand, have long emphasized color, and this forms one of the characteristics of the Swiss bees.

Poland is contemplating a law which will make it illegal to sell artificial honey bearing labels which will cause it to be mistaken for real honey. Adulterated honey in any way will also be forbidden. Under this proposed law the water content of honey for sale is not to exceed 22 per cent., and the amount of acid contained is not to exceed 0.25 per cent. Furthermore there is a provision in the law making it illegal to kill a colony by sulphuring, or otherwise, merely to obtain the honey-crop.

During the past year Austria inaugurated its first "short course" in bee diseases. This is not a new feature in Europe. The Biological Institute at Dahlem, near Berlin, for example, gives annually for the benefit of beekeepers two short courses in the bacteriology of bee diseases. The purpose of the course is not merely general information, but to give training in making scientific diagnosis. One of the courses in 1924 was given by Doctor Borchert who is in charge of the Laboratory for the investigation of bee-diseases at Dahlem.

Dozent August Ludwig of the University of Jena, known as the author of "Unsere Bienen," on the first of this year succeeded Dr. F. Gerstung as the editor of "Deutschen Bienenzucht in Theorie und Praxis." As far as is known only two men have

received an honorary Doctor's degree in recognition of their services to beekeeping. The first of these was Dr. Ulrich Kramer of Switzerland, who was thus honored by the University of Berne in 1908. Doctor Gerstung is the other, and he was thus honored by the University of Jena a few years ago.

Steps are being taken to establish at Cornell University a library of beekeeping literature. The State Federation of co-operative Beekeepers' Societies has appointed a committee to co-operate with the University in devising a plan whereby the beekeepers of the State can co-operate in this work. Plans are under way for obtaining for the library all bee-journals published in the world, and a number of complete sets of older journals have already been obtained. Several New York beekeepers have already made important contributions of old bee books for this purpose.

A short course in advanced beekeeping was held at the New York State College of Agriculture during the week of January 26. This was one of the greatest gatherings of beekeepers ever held. The program included lectures and demonstrations by a large number of out-of-state authorities, including George S. Demuth, E. R. Root, Kenneth Hawkins, C. P. Dadant, James I. Hambleton, N. E. Phillips, George H. Rea and Cyrille Vaillancourt. Dr. E. F. Phillips and Mr. R. B. Willson of the College of Agriculture took part and a number of other persons connected with the College also participated. A number of prominent New York State men were also scheduled to speak.

A conference was held at the Department of Farms and Markets, Albany, New York, on December 19 for the discussion of improvements in the apiary inspection work in New York, and it was decided to adopt the area-clean-up plan of operation on a small scale during the coming summer, this work to be done in Chemung County. Plans for the better grading and marketing of New York honey were discussed and steps will immediately be taken to adopt suitable grades for comb-honey. The conference was attended by officials of the Department of Farms and Markets, by officers of the State Federation and by representatives of the College of Agriculture. The subject of grades for New York honey was taken up at the short course at Ithaca on January 26.

Members of the staff of the Bee Culture Laboratory of the Bureau of Entomology participated in many beekeepers' meetings during the past two months. Mr. Jas. I. Hambleton attended meetings of state beekeepers' associations as follows: Springfield, Ill., on December 9: Lansing, Mich., on December 11; Worcester, Mass., on January 6; Cambridge, Md., on January 8 and Harrisburg, Pa., on January 21. On January 22–23 he attended the meeting of the American Honey Producers' League in Chicago, as well as speaking before the meeting of the Chicago Northwestern Beekeepers' Association at the same place. On January 26–30 he was on the program for the short course held at Cornell University. Mr. E. L. Sechrist attended the meeting at Cambridge, Md., on January 8, and was listed as one of the speakers for the short course at North Carolina State College on January 21–23. Mr. W. J. Nolan was on the program of the annual meeting of the Tennessee State Beekeepers' Association held January 29–30.

At the 62d meeting of German-speaking beekeepers held in Marienburg, Germany, from July 26–29, 1924, it was decided to adopt a uniform nomenclature for the various bee diseases. This task was left to a committee composed of Doctors Borchert and Zander representing Germany, Doctor Morgenthaler representing Switz-

erland, and Dozent Muck representing Austria. The two diseases known in this country as European foul brood and American foul brood were called by this committee, "Gutartige Faulbrut," and "Bösartige Faulbrut," respectively. The committee follows American nomenclature in one respect at least by adopting "*Bacillus larvae*" as the name for the causative organism of American foul brood. It is interesting to note that in the United States before the present nomenclature for the foul brood diseases was put forth by Doctor Phillips in 1906, there existed the same multiplicity of names in reference to these diseases as has been true in German-speaking countries up to the present. As a further result of action taken at the last annual meeting of the German-speaking beekeepers the proceedings of these meetings are to be published annually.

Many prominent apicultural workers visited the Bee Culture Laboratory on December 30, the date on which open house was kept for the benefit of those attending the meetings of the American Association for the Advancement of Science. The various activities of the Laboratory were represented by exhibits and explained by those in charge. Among the visitors were the following State Entomologists: Prof. G. M. Bentley of Tennessee; Dr. W. E. Britton of Connecticut; Prof. C. L. Corkins of Wyoming; and Dr. S. B. Fracker of Wisconsin. Other visitors were as follows: Dr. E. F. Phillips, formerly in charge of the Bee Culture Laboratory, but now at Cornell University; G. S. Demuth, also formerly connected with the Laboratory but now editor of *Gleanings in Bee Culture;* Prof. J. E. Eckert of the North Carolina State College of Agriculture; Prof. Bruce Lineburg of Lake Forest University; Prof. L. M. Bertholf of Western Maryland College; Prof. H. C. Severin of the South Dakota State College; Prof. J. D. Humphrey of the University of Tennessee; H. L. Fackler, Assistant Entomologist of Tennessee; E. J. Anderson, P. R. Needham, Everett Oertel and R. L. Parker, all from Cornell University; Ray Hutson of the New Jersey Experiment Station; Archie D. Shaftesbury, Instructor in Zoology at the North Carolina College for Women; and Miss Malitta B. Fischer, Secretary of the Wisconsin Beekeepers' Association.

Horticultural Inspection Notes

Mr. E. I. Smith is now in charge of the work of the Federal Horticultural Board at Astoria, Oregon.

Mr. R. W. Nicaise, who is employed as an inspector by the Federal Horticultural Board, has been transferred from New York to New Orleans, La.

Mr. Thomas J. Baker has been transferred from Astoria, Oregon to Portland, Oregon, where he is in charge of the work of the Federal Horticultural Board.

The office of the Federal Horticultural Board in New York City has been moved from Room 305 Custom House to Bush Terminal Bldg., 36 Bridge St.

Mr. Harry Sargent of the inspection force of the Federal Horticultural Board was recently transferred from Portland, Oregon to Seattle, Washington.

Oranges infected with Citrus Canker (*Bacterium citri*) were found in the stores of the American S. S. "President McKinley," at Seattle, Wash. on Dec. 19, 1924. The oranges came from China.

Mr. J. T. Rogers, in charge of the work of the Federal Horticultural Board at Charleston, S. C., was recently detailed to inspect the plants to be distributed by the

Bureau of Plant Industry from their Stations at Savannah, Ga. and Chapman Field, Fla.

Mr. W. S. Fields, an inspector of the Federal Horticultural Board who has been stationed at San Francisco for several years, has been transferred to Washington, D. C. The work which he did in California will now be carried on by the State inspectors.

Mr. E. R. Sasscer of the Federal Horticultural Board is away from Washington on a trip to the Southern ports, including New Orleans and those on the Mexican Border. While in the South he will confer with Dr. Hunter in regard to further work to be carried out in the eradication of the Pink Boll-Worm.

A shipment of 33 crates of green Pidgeon peas, or Chick peas, in pod arrived at New York recently from Porto Rico, an examination of which showed them to be badly infested with the larvae of an insect determined by Mr. Heinrich of the Bureau of Entomology as a species of *Pyralidae*.

Mr. Lee A. Strong, Chief of the Plant Quarantine Inspection Service of the Federal Horticultural Board, recently returned from a trip to several of the ports of entry in the Middle-West and on the Pacific Coast. While in California he attended the convention of the California Fruit Growers and Farmers, held in Sacramento, Dec. 9th to 11th, 1924.

The section of Horticultural Inspection of the American Association of Economic Entomologists, which met in Washington on the afternoon of Dec. 31, 1924, was well attended by persons interested in inspection work. The program was rather brief, as the time allotted for the meeting was short, but it is hoped that at the next meeting more time can be devoted to this section.

The importance of inspecting the baggage of passengers arriving in this country is emphasized by the recent finding of more than a dozen larvae of the Mediterranean Fruit Fly in one tangerine examined out of a lot of three dozen taken from the baggage of a passenger arriving in New York on the S. S. "Duilio," from Naples, Italy. The vessel came from Naples direct, and carried 1100 passengers.

Several interceptions of Pomelos have been made recently by inspectors of the Federal Horticultural Board, in shipments coming from China. They were consigned as vegetables along with vegetable products which are ordinarily permitted entry. A case of fresh Olives has also been taken in a similar shipment. On one lot of Pomelos a very interesting fungus was found, which the pathologists believe to be new.

The Federal Horticultural Board inspector at the Charleston, S. C. office, made a rather important interception on Oct. 27, 1924. A trunk, the contents of which were manifested as "one case preserves in tin," arrived at Charleston on the S. S. "Mohawk," from Palermo, Italy via New York. An examination showed the trunk to contain Artichoke roots infested with several insects, all common except for two species; one, a Cryptorhynchid weevil, which is not present in the National Museum Collection and regarding the habits of which nothing is known; the other, a Lepidopterous larva, which was identified by specialists as a species of *Eucosma*, a root borer which is injurious to plant life.